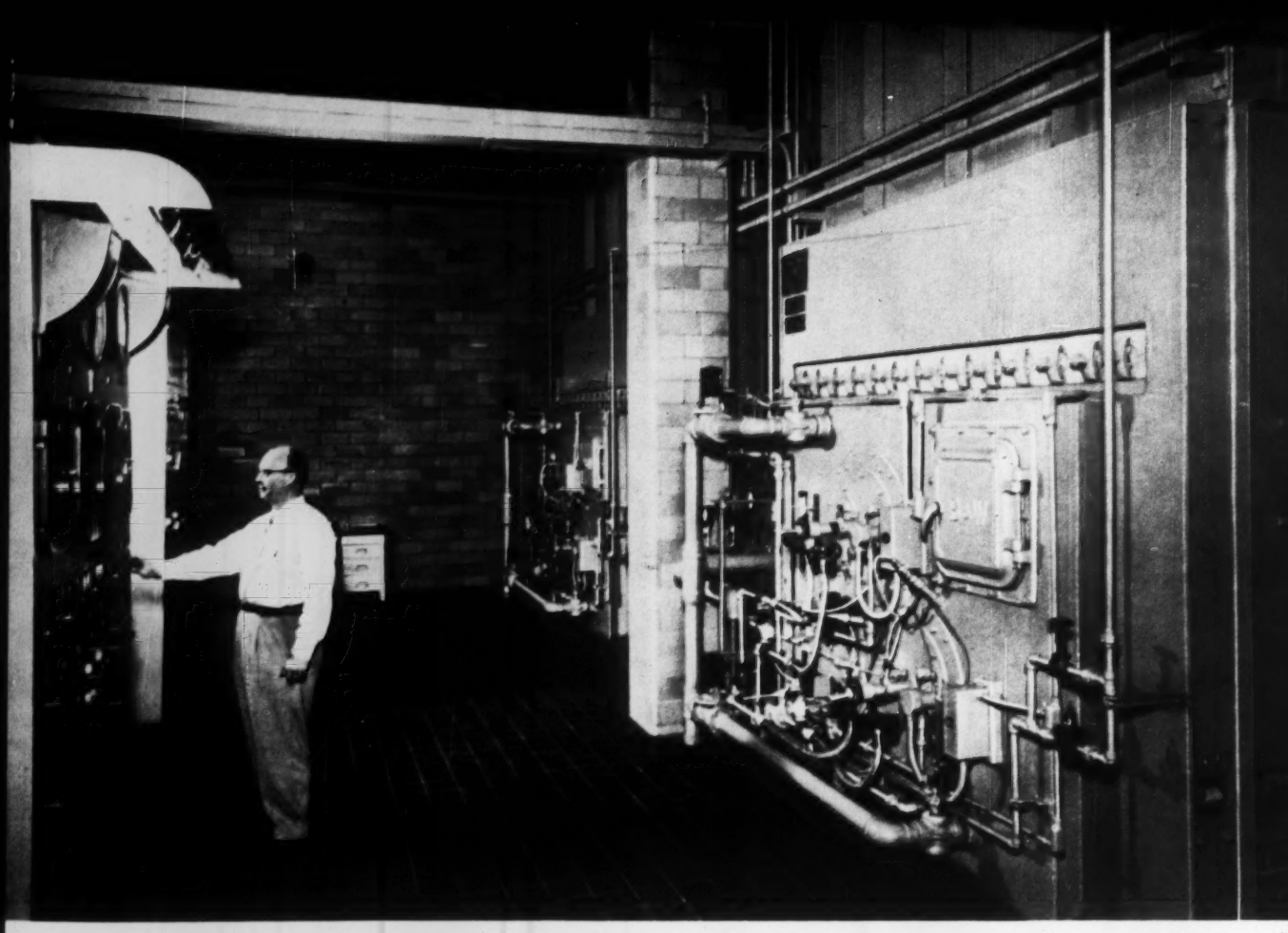
MECHANICAL ENGINEERING

December 1957

in this issue



Hospitals Turn to B&W Integral-Furnace Boilers for Reliable Supply of Clean, Dry Steam

Every day, year after year, even the routine activities of a hospital are vital. The continuous, reliable services expected from hospitals must be matched by the equipment upon which they depend.

Institutions like St. Mary's Memorial Hospital at Knoxville, Tenn., have come to depend upon the reliability and continuity of operation offered by B&W Integral-Furnace Boilers. Cleanliness of operation, high fuel economies, and maximum capacity in small boiler room space are other benefits of these units which appeal to health and budget-conscious hospital management.

Modern, efficient steam supply with ample capacity for future needs, which include a new 105-bed wing and 150-bed nurses' residence with classrooms and auditorium, are being provided at St. Mary's Hospital by two new B&W Boilers.

Flexibility of the B&W Integral-Furnace design is another of the many reasons why St. Mary's and scores of other hospitals throughout the country have selected B&W. The new boiler at Knoxville is oil and gas-fired, with provision made for the installation of a stoker for future coal firing.

Rapid response to steam demands, dependable supply of clean, dry steam, and the ready availability of a nationwide service staff, have given B&W Boilers preference among those who specify and buy for hospitals and institutions throughout the nation.

B&W provides a single responsibility in design, engineering, manufacturing, installation, and service through a national network of plants and engineers.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

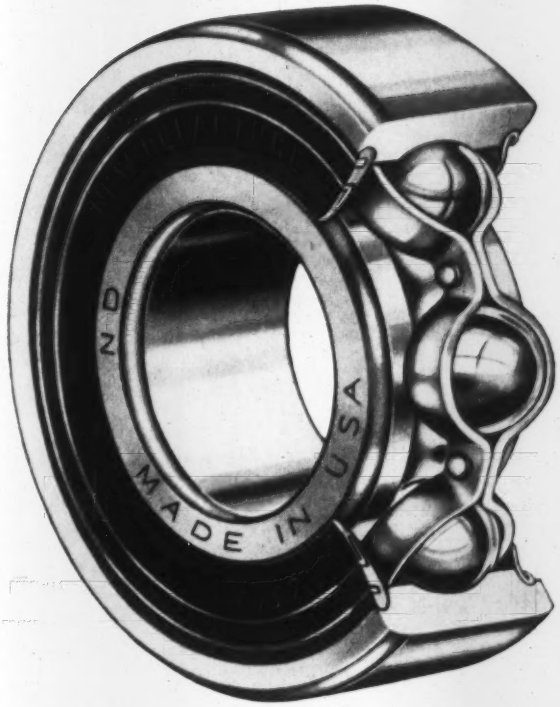
Two B&W Integral-Furnace Boilers at St. Mary's Hospital have capacity of 30,000 lb. of steam per hour each at operating pressure of 110 psi. Design pressure of 160 psi. Architect: David B. Liberman, Knoxville, Tenn. Consulting Engineer: Albert F. G. Bedinger, Knoxville, Tenn.

G-851-FF

BABCOCK & WILCOX

BOILER DIVISION

ND FACTS

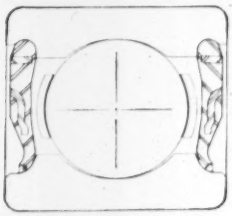


on guard against dirt and wear!

The unique design of the Sentri-Seal gives optimum protection against dirt, and includes a number of other major advantages.

Sentri-Seals can be removed, easily replaced. As the seal is of synthetic rubber in which two metal rings are embedded, a constant-rate spring is created between the rings. Inherent flexibility prevents distortion of the bearing outer ring due to seal insertion, permitting the use of bearings to the higher accuracy specifications. The spring action maintains an efficient sealing contact with the bearing ring to bar dirt and retain lubricant. Sentri-Seals are relatively inert to oils and greases and operate satisfactorily through a temperature range of −40°F. to 225°F. Specifications available for still higher temperatures. In applications where relubrication is desired, it is easily accomplished by the injection method.

Write for full details on Sentri-Seal



The diagram shows in section the New Departure Sentri-Seal. Lip-contacting surfaces are ferm-ground simultaneously with the ball race, giving an extremely high degree of concentricity between sealing surfaces and the raceway.

1908–1958
GM
FORWARD FROM FIFTY

Sentri-Seal is available for a range of sizes in single-row, standard-width bearings and also in two types of New Departure adapter bearings. Sizes, dimensions and capacities are listed in the latest New Departure catalog.

ND NEW DEPARTURE
DIVISION OF GENERAL MOTORS, BRISTOL, CONN.
NOTHING ROLLS LIKE A BALL

MECHANICAL ENGINEERING, December, 1957, Vol. 79, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢, to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

FRACTIONAL HORSEPOWER GEARING

GEAR Specialties, Inc.

2635 WEST MEDILL AVENUE
CHICAGO 47, ILLINOIS

SPURS • SPIRALS • HELICALS • BEVELS • INTERNALS
WORM GEARING • RACKS • THREAD GRINDING

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARING

Get famous G.S. precision in HOBBED PINION RODS...

You rule out assembly slow-downs, assure consistent, quiet performance of your product, when you specify G.S. Hobbed Pinion Rods... available up to ⅛" diameter, up to 12 feet in length, in various shapes and materials. Why? Because G.S. specialized experience, specialized equipment, specialized techniques, *and rigidly controlled precision processes* mean unsurpassed quality in G.S. production runs of all forms of Small Gearing—Spurs, Spirals, Helicals, Bevels, Intervals, Worm Gearing as well as Pinion Rods.

The greatest names in U.S. industry depend on G.S. Small Gears. We can serve your most critical needs as we serve theirs—let our Small Gear experts work out your problems with you.

SEND FOR *G.S. technical data, free! See where and how we mass-manufacture Small Gearing to uniformly fine tolerances. Folder contains 23 pictures of Small Gears, plant view, as well as Diametral and Circular Pitch Tables. Ask for your copy on company stationery, please!*

41 Years of Specializing in Small Gearing!

MILLIONS OF SHARP, SUPERHEATED PARTICLES, traveling at high velocities, quickly wear dust collector linings, mains, downcomers, etc. Metals and most ceramics simply can't withstand this harsh abrasion. But CARBOFRAX refractories can—even at temperatures as high as 2500°F. A CARBOFRAX dust collector lining in an ore sintering machine is, for example, still in use after 10 years' service.

Refractories . . . to resist abrasion

Exceptional resistance to abrasion—whether caused by tiny gas-borne particles or sliding steel billets—is one of the most useful properties of several of Carborundum's unique refractory materials. For example, when used in the exhaust lines of gasoline catalytic cracking units in temperatures ranging up to 1200°F, these refractories lasted 3 years, as compared to alloy rings which lasted for 6 months.

And when abrasion is combined with higher temperature, the exceptional resistance of these super refractories becomes even more apparent and useful. As skid rails in furnaces which heat 6-lb. billets to 2250°F—pushing 250 slugs an hour—CARBOFRAX® silicon carbide refractories need one-third the replacement, one-third the labor and one-third the down-time of ordinary rammed chrome ore hearths. Other successful applications include: dust collectors, gas scrubbers, transfer pipe lines, hydro cyclones and process equipment parts, to name but a few.

Many applications call for other properties in combination with wear resistance. Among Carborundum's many materials are refractories that also offer excellent heat shock resistance with sufficient hot strength to withstand 25 psi at 3128°F. Others provide unique resistance to corrosion as well as abrasion. These properties are but a few of those to be found in super refractories pioneered by Carborundum. Among them, you are almost certain to find answers to your refractory and high-temperature problems. For help, fill in and mail this coupon:

CARBORUNDUM
Registered Trade Mark

---------- MAIL THIS COUPON TODAY ----------

Dept. I 127, Refractories Division,
The Carborundum Company, Perth Amboy, N. J.

Please send me:

- ☐ Forthcoming issue of Refractories Magazine
- ☐ Bulletin on Properties of Carborundum's Super Refractories
- ☐ Here is a description of my high temperature problem. Can you help me?

Name _____ Title _____

Company _____

Street _____

City _____ Zone _____ State _____

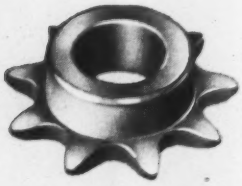
WHATEVER THE APPLICATION...

you can improve your product with

GRAMIX®

(PRODUCT OF POWDER METALLURGY)

PRECISION FINISHED PARTS



Hardened steel drive sprocket for lawnmower

Aircraft control cable guide

Self-aligning guide bearing for industrial blower shaft

GRAMIX precision finished parts are improving products in virtually every branch of industry. A pump manufacturer, for instance, may specify a gasoline pump rotor made of GRAMIX and gain a number of advantages.

To begin with, the alloys are carefully blended to meet his individual requirements. The GRAMIX parts are then die-pressed to exact shape, sintered under rigid control and finished to tolerances as close as .0005". (This process, of course, costs far less than machining, forging or casting.) The manufacturer can expect the GRAMIX gasoline pump rotor to do a better job because *all* GRAMIX parts are precision engineered and precision controlled from alloying to finishing.

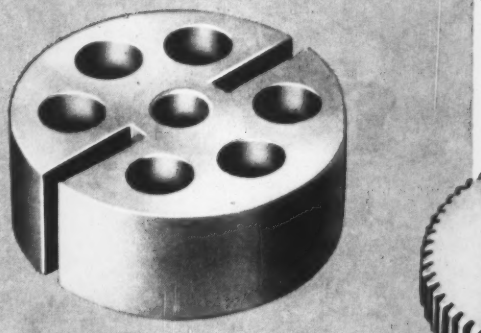
No matter what the application may be, GRAMIX parts fit specifications exactly. Parts may be impregnated with oil . . . to insure a longer life and a quieter operation: if specified, the GRAMIX parts may be coined and work hardened, even prepared for plating.

The rotor is only one of thousands of applications in which GRAMIX precision finished parts have proved to be ideal. Just a few of them are shown here, so consider the components of your products . . . there may be several that could be improved . . . with GRAMIX! Products of powder metallurgy you can rely on.

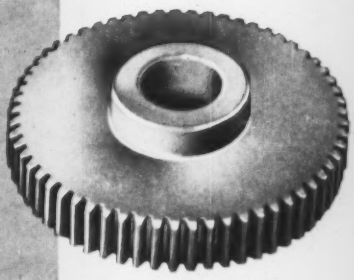
PM PM MEMBER

THE UNITED STATES

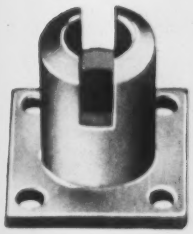
GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



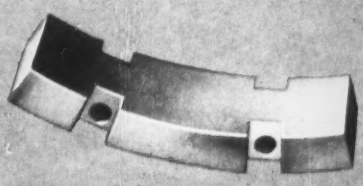
Automotive compressor rotor



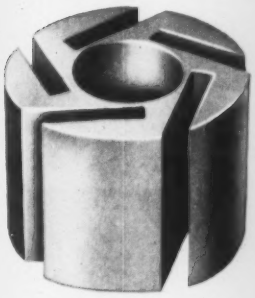
Infiltrated iron gear for lawnmower



Iron switch control

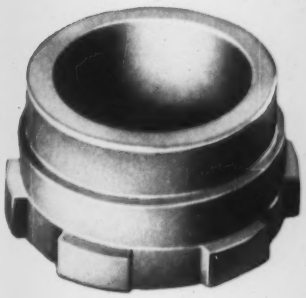


Iron clutch segment

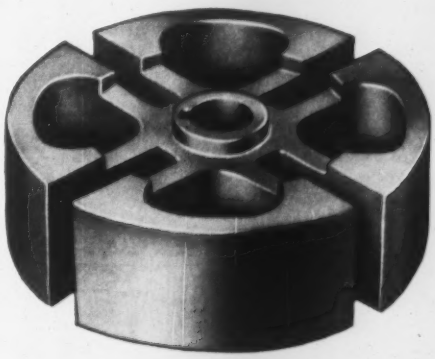


Rotor for gasoline pump

Packing gland follower used in hydraulic system



Write today for factual Engineering Bulletin No. 21 . . . we'll send your copy right along.



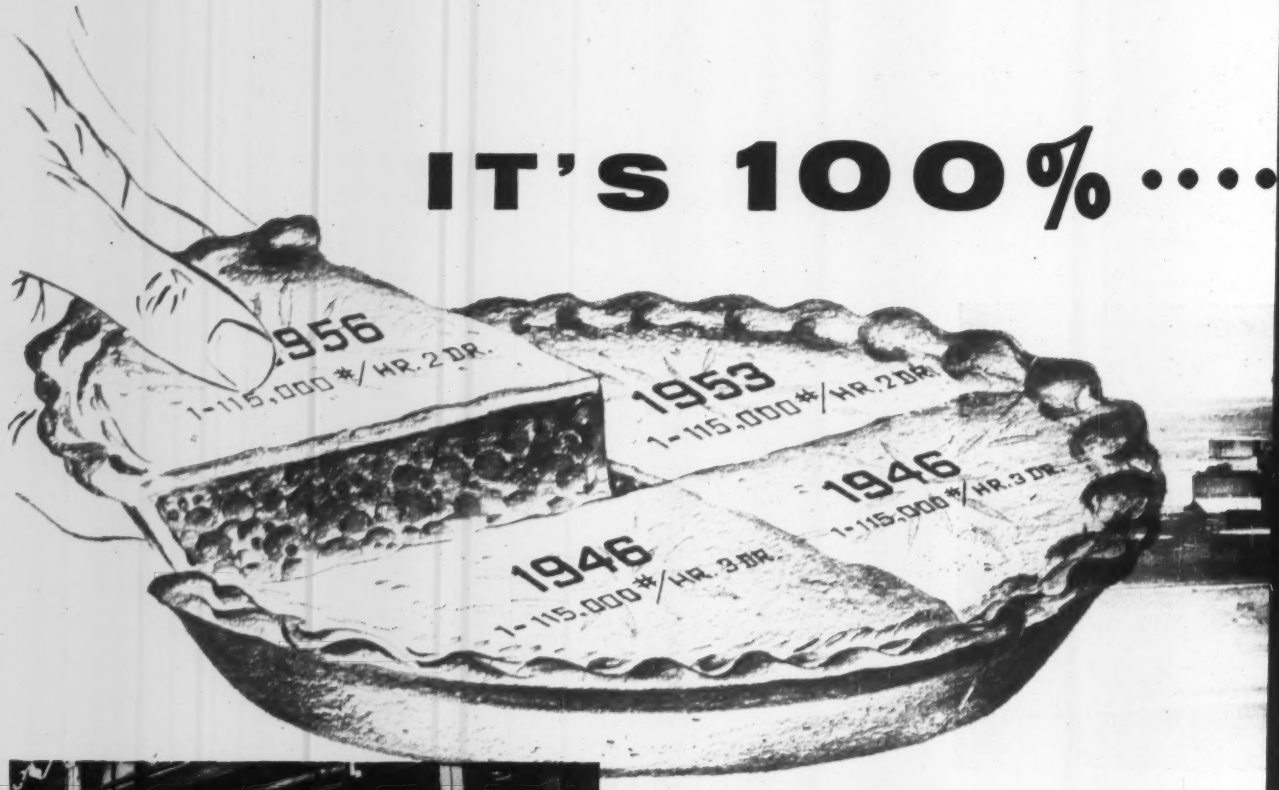
Bronze rotor in high speed fueling unit

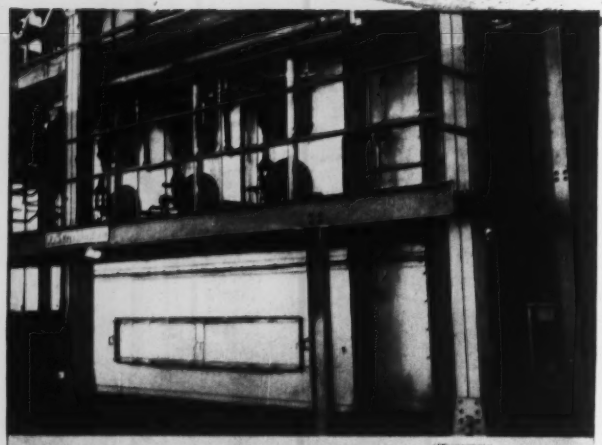
X-253-1

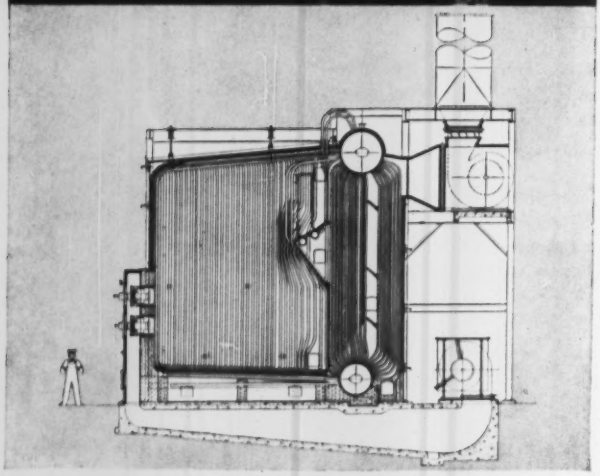
GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

IT'S 100% ....







2 Repeat Orders make it 100% Erie City at Casper, Wyoming

1946

2 — 115,000 lbs./hr. steam generators

1953

1 — 115,000 lbs./hr. steam generator

1956

1 — 115,000 lbs./hr. steam generator

Significant Data:

Boiler Capacity	115,000 lbs./hr.
Operating Pressure	225 lbs.
Design Pressure	250 lbs.
Total Temperature	450° F.
Superheaters	Erie City
Firing	Oil and Gas

ERIE CITY at CASPER, WYOMING

TEXACO
REG. T. M.

Water Conditions . . . Tough Steam Quality . . . . . Tops

• Proof of the pie is in the eating. In 1946 the Texas Company of Casper, Wyoming installed two 115,000 lbs./hr. boilers, liked what they got, and came back for more in 1953 and 1956. Repeat business is good business because it shows customer satisfaction.

Especially gratifying were these repeat orders because they involved working with tough water conditions. Starting with river water — high in hardness and containing abnormal quantities of dissolved and suspended solids — the properly designed Erie City steam separators, steam scrubbers and boiler layouts produce top quality, clean, dry steam.

Such repeat business results from a thorough understanding of the problem and the application of sound engineering, top quality materials and skilled workmanship. Investigate the use of Erie City Steam Generating equipment in your plant — write for Bulletin SB-504L.

ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

SEE HOW SOUTHERN NITROGEN USED ALCOA ALUMINUM TO BAN CORROSION

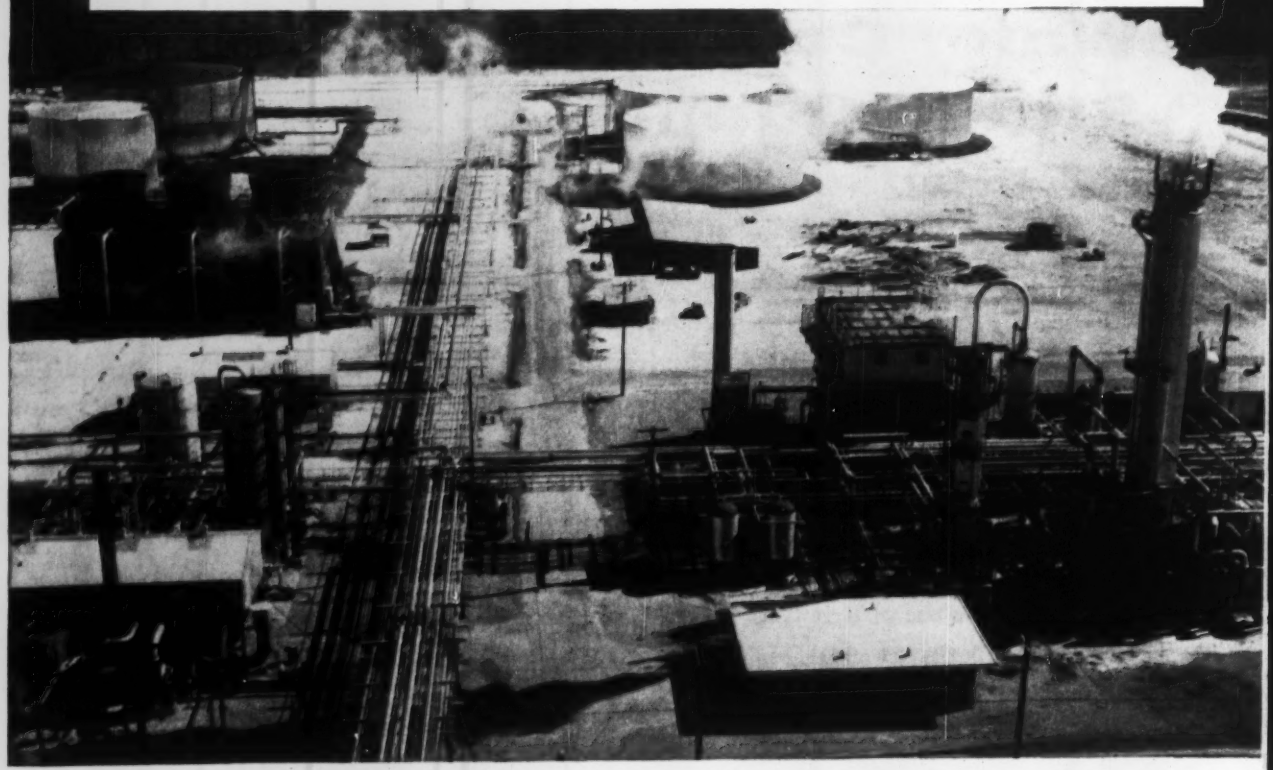
Southern Nitrogen Corporation, the South's newest nitrate fertilizer producer, recently completed a $14-million plant near Savannah, Georgia. Nearly everywhere you look in this modern processing operation you see ALCOA® Aluminum (over 500,000 lbs) at work to combat corrosion. The photographs on these pages show a few of the many ways it is used there.

It's easy to see why Southern Nitrogen used so much ALCOA Aluminum. No other metal provides so many valuable benefits for such a wide variety of uses. And ALCOA, alone, can offer unparalleled technical assistance based on over 30 years' experience applying *all these aluminum advantages in the process industries:*

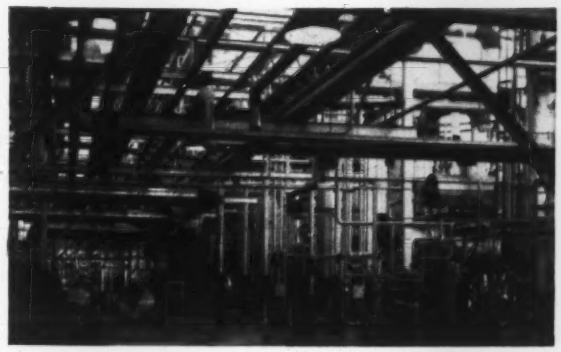
- *Excellent corrosion resistance* extends service life and reduces maintenance to a minimum.
- *Light weight—high strength* make handling easy and economical . . . often permit substantial construction economies.
- *High thermal conductivity* combined with corrosion resistance often makes aluminum the lowest cost material suitable for many demanding heat transfer operations.
- *Nonsparking!* • *Nonmagnetic!* • *High reflectivity!*
- *Excellent electrical conductivity!*

The plant designers, The Girdler Company, made full use of all the advantages of working with ALCOA. They were able to employ the unequaled aluminum experience of ALCOA engineers . . . to help them choose the right aluminum alloys and fabrication methods for dependable, corrosion-free service in every part of the plant.

When *you* have a metal problem, call on ALCOA to find a sound, economical aluminum answer. Consult the nearby ALCOA sales office listed in the Yellow Pages of your telephone directory. Or outline your metal needs in a letter to ALUMINUM COMPANY OF AMERICA, 908-M Alcoa Building, Pittsburgh 19, Pa.

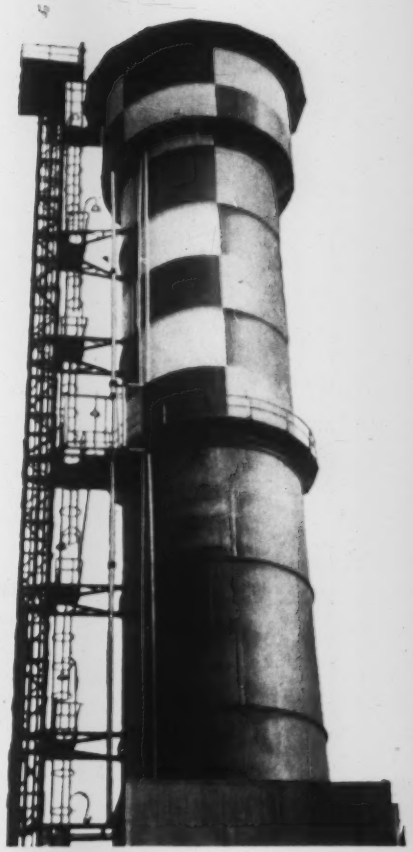


The Girdler Company designed this huge new nitrate fertilizer plant for Southern Nitrogen Corporation. The plant is designed for annual production of 120,450 tons of ammonium nitrate fertilizer, 91,250 tons of nitric acid, 10,950 tons of urea and 328,500 tons of fertilizer solutions.

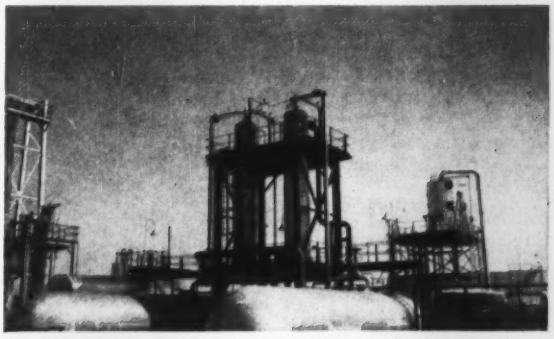


Plant employs thousands of feet of Alcoa Aluminum piping and conduit and is liberally painted with highly reflective aluminum coatings.

These 1,650,000 gallon storage tanks of Alcoa Aluminum alloy 5052 successfully fight the corrosive action of 85% ammonium nitrate. The tanks, 94 ft in diameter by 32 ft high, were built by Chicago Bridge & Iron Co.

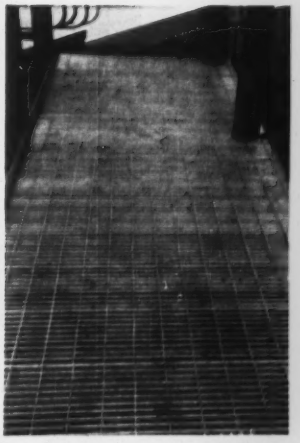


Corrosion-resistant Alcoa Aluminum (alloy 6061-T6) was used throughout this prilling tower . . . to prolong service life without frequent, costly maintenance shutdowns. Built by The Steel Products Co., Inc., Savannah.



Alcoa Aluminum in these ammonia absorber coolers prevents corrosion while providing constantly high heat transfer efficiency. Coolers built by Henry Vogt Machine Co.

The superior corrosion resistance of Alcoa Aluminum in tank cars prolongs service life and prevents product contamination. Tanks built by Graver Tank & Mfg. Co., Inc. for Union Tank Car Co.



Lightweight gratings of Alcoa Aluminum are used in traffic areas throughout the Southern Nitrogen plant. They stand up under heavy traffic and easily withstand the attack of corrosive industrial atmospheres.

Alcoa Aluminum in electrical bus bar, conduit, fixtures and enclosures gives Southern Nitrogen effective protection from electrical breakdowns during prolonged exposure to corrosive industrial atmospheres.

NEW!
"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ALCOA
ALUMINUM
ALUMINUM COMPANY OF AMERICA

Weld Specifications

Tension tests are required to be made at room temperatures and at 670° F. The following minimum physical properties shall be met:

At Room Temperature:

TS	YS	EL	RA	CHARPY V-NOTCH
70,000	30,000	45	50	50

At 670° F. the minimum tensile strength shall be 51,000 p.s.i. and the minimum yield strength 18,300 p.s.i.

Rejection

Each casting that develops unacceptable defects during shop working or fails to conform to all of the requirements of these specifications shall be rejected. No repair by welding or other means will be permitted.

Radiographic Inspection

(a) Paragraph S5 (a) of the Supplementary requirements of ASTM-A 362-52T.

(b) All castings shall be radiographed 100% and shall conform to ASTM-E7 1-52, Class 2 quality, except as modified by these specifications.

(c) The manufacturer shall establish a positive system of identification of the X-ray plates which shall be subject to approval by the inspector. This system shall guarantee complete coverage by radiographing and provide for positive identification between the plate and the subject.

Inspection of Penetrants

All castings shall be subjected to inspection by fluorescent penetrants or penetrating dyes both inside and out. All cracks, porosity, or flaws revealed as a result of the Dye Penetrant Test shall be due cause for rejection of the casting.

All cast pipe shall be hydrostatically tested to 5,900 p.s.i. and held at that pressure for 20 minutes with zero pipe leakage. Each length of pipe shall be hydrostatically tested at the manufacturer's plant.

The 304L stainless steel shall conform to the following ladle analysis:

Carbon	.03 max.		
Manganese	1.50% max.		
Phosphorous	.03% max.		
Sulphur	.03% max.		
Silicon	2.00% max.		
Chromium	18.00	-	21.00%
Nickel	8.00	-	11.00%

Pipe: All pipe of the following sizes shall be centrifugally cast stainless steel as per ASTM-A 362-52T, except as modified by these specifications:

16" - Sch. #160
12" - Sch. #160
10" - Sch. #160
8" - Sch. #140

All pipe shall be machine finished to 125 micro-inch interior and exterior.

for nuclear power met by U.S. PIPE patented process

Centrifugally Cast Stainless Steel Solves Many Piping Problems

Combinations of temperatures, pressures and corrosive conditions never encountered before: these are among the piping problems that must be overcome by the men who design the nation's nuclear power installations.

Stainless steel centrifugally cast pipe provides many of the answers. Study the specifications at the left . . . specifications demanded of stainless steel pipe on a recent job for Paul Hardeman, Inc., Los Angeles, California. This pipe is being used for heavy duty, high pressure, elevated temperature service in the primary piping system of the SPERT-III Reactor at the U.S. Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Idaho. The Stearns-Roger Mfg. Company, Denver, Colorado, is the architect-engineer on this project. A complete tabulation of the actual test data obtained on this pipe and to this specification is available upon request.

U.S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses—in large and small quantities—and to individual specifications.

If piping of the type described above is the bottleneck in your nuclear power planning, write and outline the problem.

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"

Wall Thickness—⅛" and up

Length—Up to 16'

Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

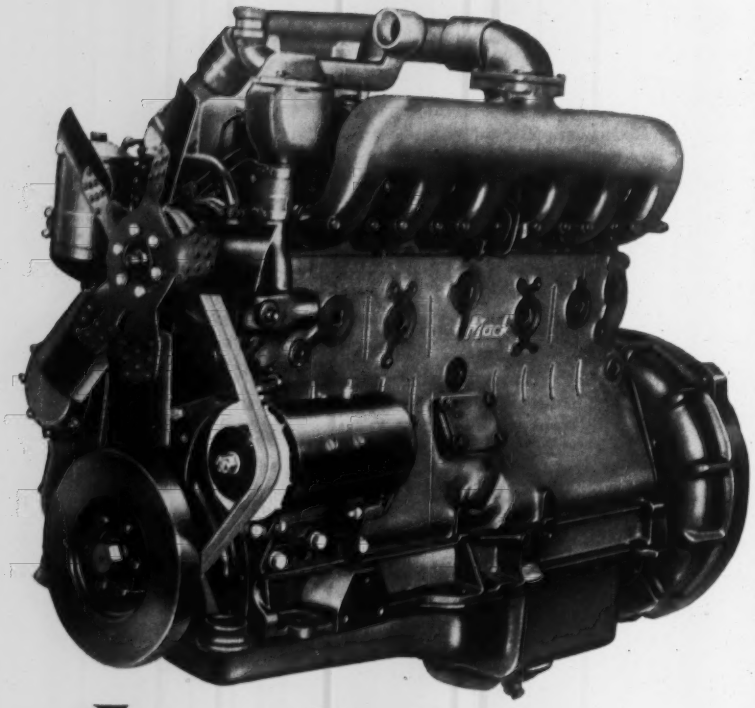
STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, PITTSBURGH, HARTFORD, BURLINGTON

REDUCE CRANKSHAFT VIBRATION

. . . in Diesel Engines

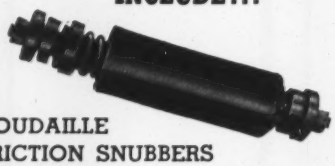


with a HOUDAILLE TORSIONAL VIBRATION DAMPER

A Inertia mass or flywheel
B High viscosity synthetic fluid
C Hermetically sealed housing

THE SHEARING ACTION of highly viscous fluid, used exclusively in the Houdaille damper, makes it the *most practical, most efficient* method of reducing torsional vibration in diesel engine crankshafts. A true damper and not a detuning device, it is effective across the full range of engine criticals. To diesel and gasoline engine manufacturers, it offers greater horsepower and speed . . . to diesel engine users it means smoother operation, longer life and less maintenance.

OTHER OUTSTANDING HOUDAILLE DEVELOPMENTS INCLUDE...



HOUDAILLE FRICTION SNUBBERS

Designed for use on freight and passenger car trucks, to control excess vertical movement and help protect lading on uneven tracks and curves.

HOUDAILLE ROTARY SHOCK ABSORBERS

Engineered and built to outlast and outperform linear type shock absorbers. Available in a wide range of designs, for original equipment or replacement use on railway passenger cars, motor trucks, buses, tractors and farm equipment, and other heavy duty vehicles. Exclusive external valve adjustment . . . easy to service without being removed.

EXPERIENCED ENGINEERS

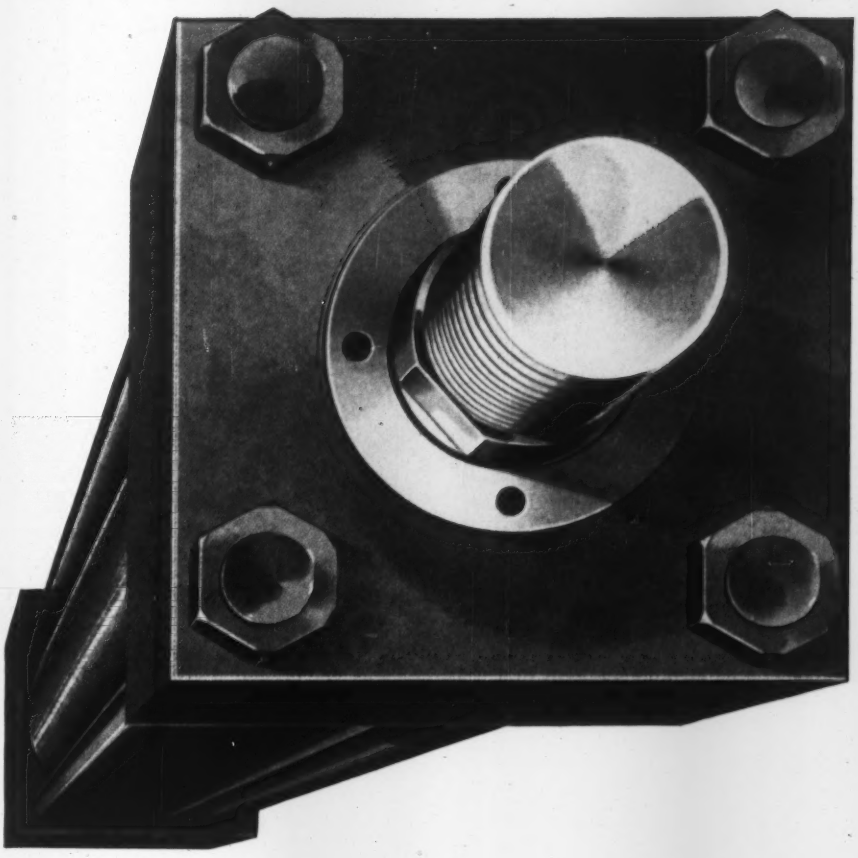
and precision production facilities at Houdaille are at your service for any application involving hydraulics. Write Department ME for specifications and performance data on Torsional Vibration Dampers, Rotary Shock Absorbers or Friction Snubbers

HOUDAILLE INDUSTRIES, INC.

BUFFALO HYDRAULICS DIVISION

537 East Delavan Avenue Buffalo 11, N. Y.

AT YOUR REQUEST...



ANKER-HOLTH

Hydraulic Cylinders now available in Square Head design

Positive Trouble-free Performance

Anker-Holth Division, for 18 years designers and manufacturers of quality air and hydraulic power cylinders, now offers a standard line of all steel, high pressure square head tie rod cylinders. Important new operating features and design achievements assure positive controlled power for a wide range of industrial applications.

Standardized Mountings for Interchangeability

Conservatively rated at 2000 P. S. I. working pressure and 3000 P. S. I. non-shock pressure every cylinder is proof tested at 4500 P. S. I. All mountings are available, standard bores from 1½ to 8 inches. Standardized mountings provide complete interchangeability with most makes of square head cylinders. The Anker-Holth "□" line meets all J. I. C. specifications.

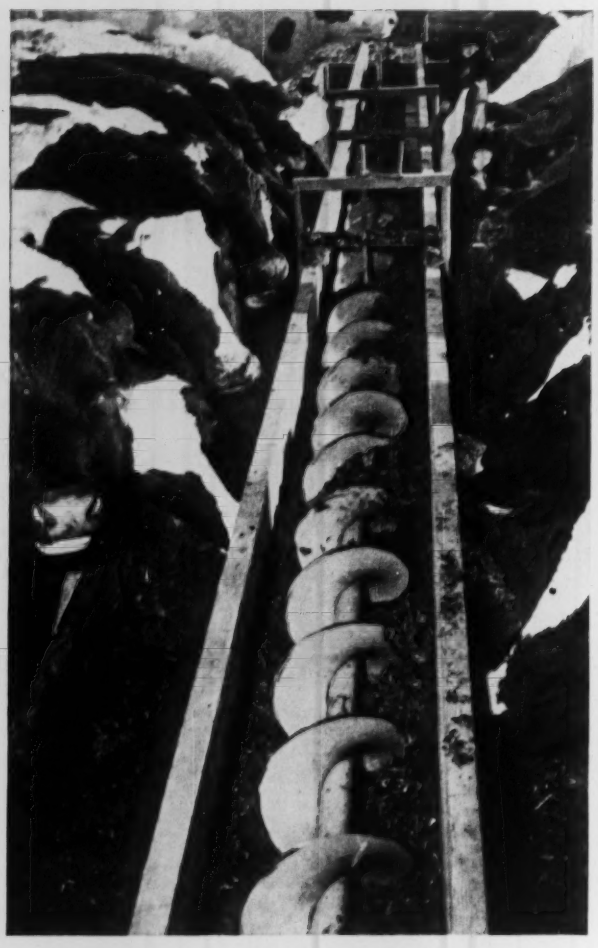
For more information contact your local Anker-Holth representative or Anker-Holth Division, Port Huron, Michigan. YUkon 5-7181

ANKER-HOLTH DIVISION

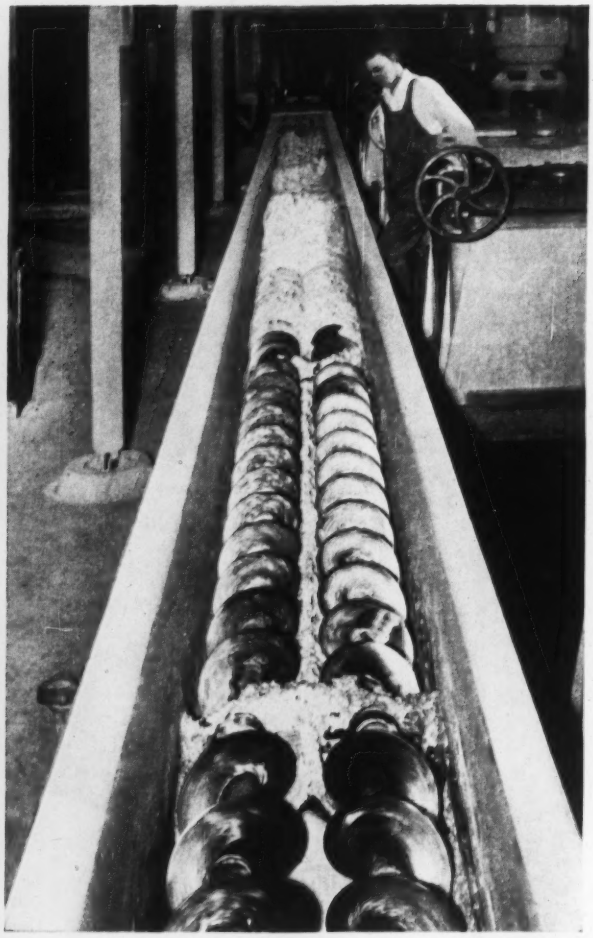
THE WELLMAN ENGINEERING COMPANY

2727 CONNOR STREET, PORT HURON, MICH., U. S. A.

New twists with ancient conveying method



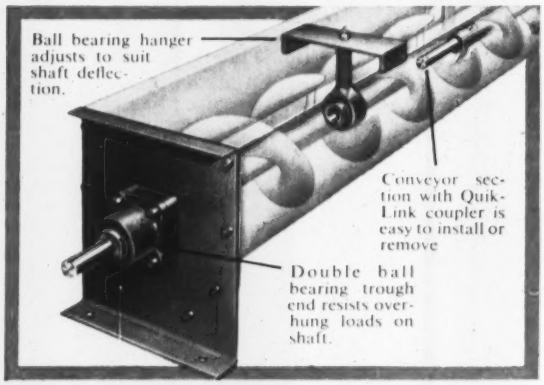
ON THE FARM — pushbutton cattle feeding is one of limitless possibilities for mechanizing chores with Link-Belt augers. From combines to post hole diggers . . . handling feed or harvesting forage—their long wear and minimum of parts practically eliminate maintenance.



IN THE FACTORY — Link-Belt can furnish a single screw or a complete, coordinated materials handling system built around these conveyors. They handle anything from this wet, gummy pulp to light or heavy, fine or coarse, sluggish or free-flowing material.

Link-Belt introduces new components for screw conveyors to reduce power requirements, simplify maintenance

SIMPLICITY and versatility have promoted wide use of screw conveyors throughout industry . . . on scores of conveying and elevating jobs. And recent Link-Belt refinements more than ever encourage alert industrial designers and manufacturers to work screw conveyors into their equipment or operations. Check the profit and cost-saving possibilities for your firm by writing LINK-BELT COMPANY, Dept. AV, Prudential Plaza, Chicago 1, Ill. 14.699

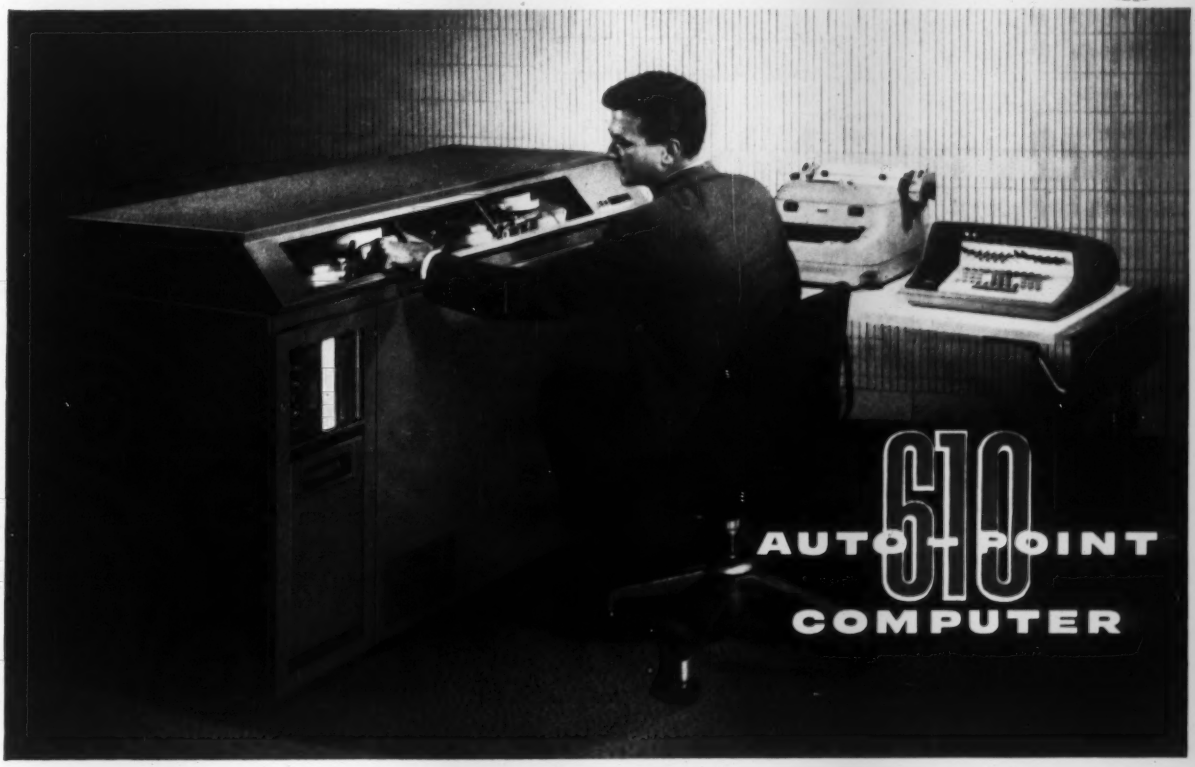

Ball bearing hanger adjusts to suit shaft deflection.
Conveyor section with Quik-Link coupler is easy to install or remove
Double ball bearing trough end resists overhung loads on shaft.

THE LATEST FROM LINK-BELT. A new line of components—several incorporating Link-Belt self-aligning ball and roller bearings—reduces friction and maintenance, cuts power requirements significantly. Part of industry's most complete line of screw conveyor products, they're interchangeable on existing systems.

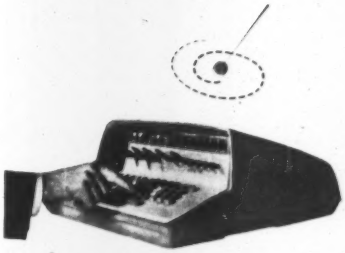
LINK-BELT

One source . . . one responsibility for materials handling processing and power transmission equipment

NEW LOW-COST COMPUTER WITH ADVANCED COMPUTING TECHNIQUES



The only desk-side electronic computer with direct programming and automatic positioning of decimal point



A few applications of the 610 Auto-Point Computer

Cam Design

•

Vibratory Analysis

•

Stress and Strain Calculations

Two *exclusive* features of the new IBM 610 Auto-Point Computer help make your engineering time more completely creative. First, direct programming: computation takes place as the program *is being written,* eliminating the need for separate program test runs. Second, automatic positioning of decimal point: the engineer is relieved of the burden of planning movement of the decimal point, greatly reducing problem-solution time.

The new Auto-Point Computer also gives you, among other valuable features, single-instruction square root, simultaneous division and multiplication, and highly flexible tape units. The IBM 610 was designed with reliability as a prime consideration; built-in self-checking provides assurance of accuracy. In addition, this low-cost electronic desk-side computer does not require air conditioning.

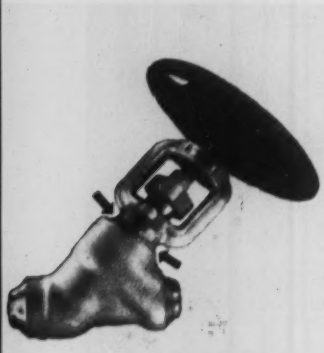
Discover today how the mobile IBM 610 can solve a wide range of scientific and engineering problems for *your* business. For details, simply call the local IBM representative.

IBM TIME EQUIPMENT

TIME EQUIPMENT · DATA PROCESSING · ELECTRIC TYPEWRITERS · MILITARY PRODUCTS

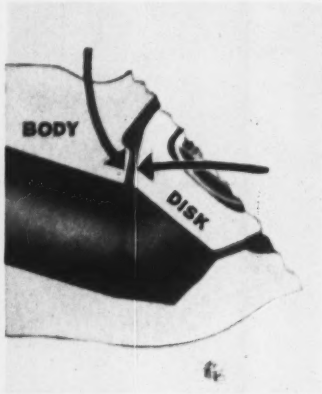
How To Make Your FIRST Buy

Rockwell-Edward forged steel inclined



WELDED BONNET CAN'T LEAK

Seal-welded body-bonnet joint maintains pressure tightness in any service. Weld easily removed for disassembly. Threaded section and body shoulder carry pressure load and give accurate alignment. Exclusive Impactor handwheel, shown here, available only on 2½ in. size.

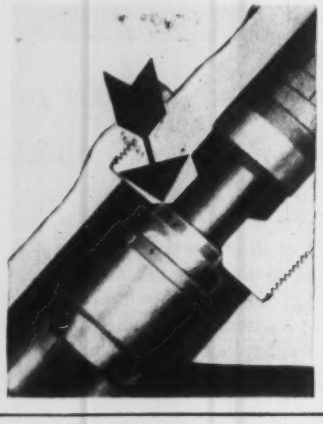


HARD-FACED INTEGRAL SEAT

Continuous Stellite ring (arrows) applied to body and disk retains hardness at high temperature; resists corrosion and erosion. Stellited seat is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.

TIGHT BACKSEAT SAVES PACKING

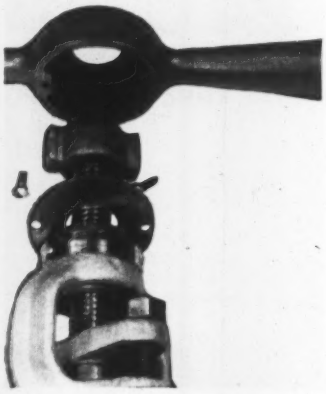
Radiused disk nut contacts plane beveled surface at the bottom of the bonnet, gives high load line contact capable of penetrating oxidation to create complete isolation of packing chamber from line pressure. This minimizes maintenance, increases packing life



CROSS ARM IMPACTOR* HANDLE

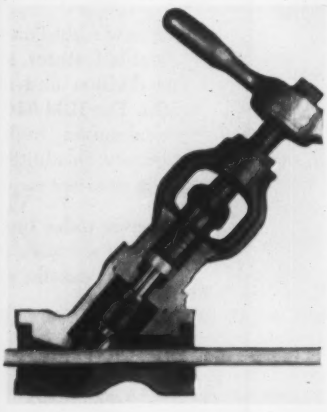
Now the famous Edward Impactor principle is applied to the larger forged steel Univalves. Delivers 2.8 times the closing load of ordinary handwheels. Assures tight seating with minimum effort in minimum space. Knobbed easy-grip handwheel on smaller size Univalves.

*T M. Reg. U.S. Pat Off.



WIDE RANGE OF USES

For steam, water, oil or gas: wherever pressure and/or temperature demand a dependable high-pressure valve the Univalve will do the job best. One line of standard valves will perform all drain, vent, bypass, blow-down, instrument take-off and all but the most difficult throttling functions. Shown here is a pair of Univalves used for boiler blow-off service.



STREAMLINING CUTS FLOW RESISTANCE

Inclined stem and internal streamlining cut turbulence, reduce pressure drop, minimize wear. Edward scientists incorporate precise streamlining in every Edward valve. Wood dowel through bore of this Univalve demonstrates straight-through design.

Rockwell-Built Edward Valves

The RIGHT Buy In Steel Valves

stem Univalve* is a good example . . .

The original cost of steel valves is often only the *beginning* Frequently, on the heels of installation, comes a series of repairs (involving cost and service interruption) ending in premature replacement. How much *less* costly it is, in terms of cash and down-time, to buy steel valves which are "right"—right from the start.

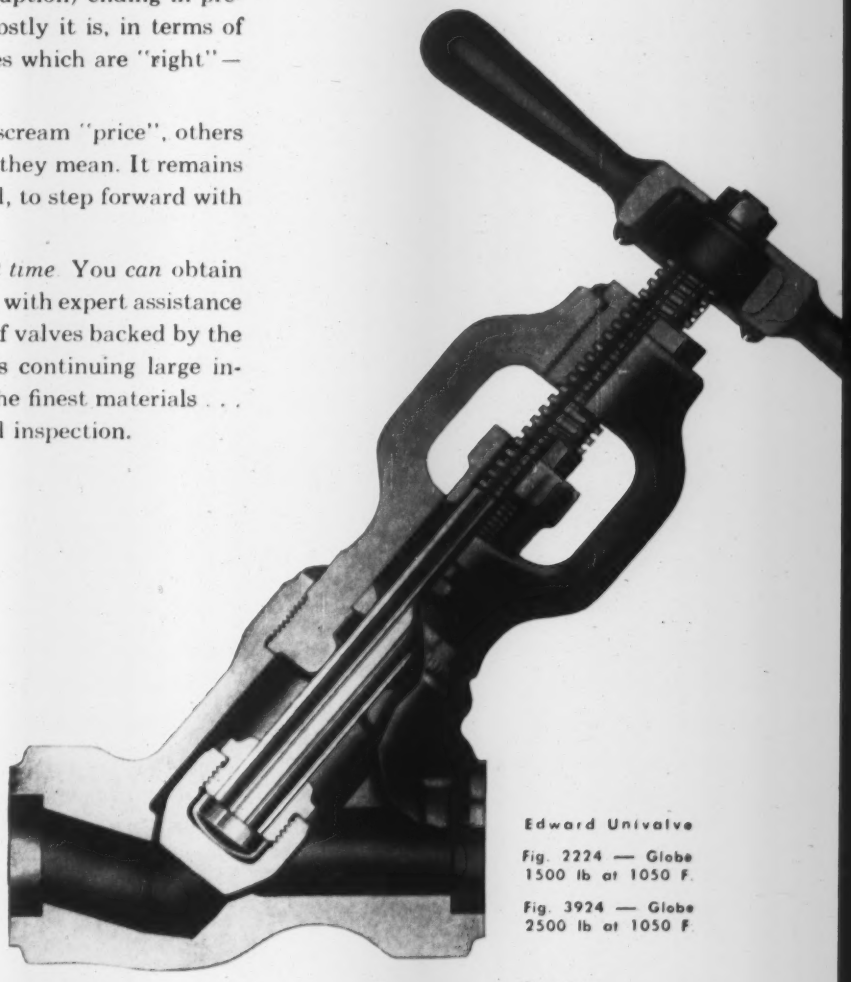
This isn't always easy Some valves scream "price", others assert "quality" without defining what they mean. It remains for Edward, long-time leader in the field, to step forward with a word of quiet assurance.

It *is* possible to "buy right" the *first time* You *can* obtain steel valves exactly right for your needs, with expert assistance every step of the way. You can be *sure* of valves backed by the Edward reputation . . . the company's continuing large investment in valve research . . . use of the finest materials . . . and the most careful craftsmanship and inspection.

UNIVALVE A GOOD EXAMPLE

Edward valves do not cost substantially more than competitive valves. But they give you a *great deal* more for your valve dollar. A case in point is that of the Edward inclined stem Univalve* pictured on these pages. At right, it appears in entirety; at left, upon the facing page, are a half-dozen of the premium features you will find in this valve. They invite your attention.

We respectfully suggest a visit from your Edward Representative. Technically trained, thoroughly experienced, his professional advice can save you headaches and money. There is no obligation, of course. Whether you are interested in steel valves for original installation or for replacement, it will pay you well to get in touch with us *today*.



Edward Univalve

Fig. 2224 — Globe
1500 lb at 1050 F.

Fig. 3924 — Globe
2500 lb at 1050 F.

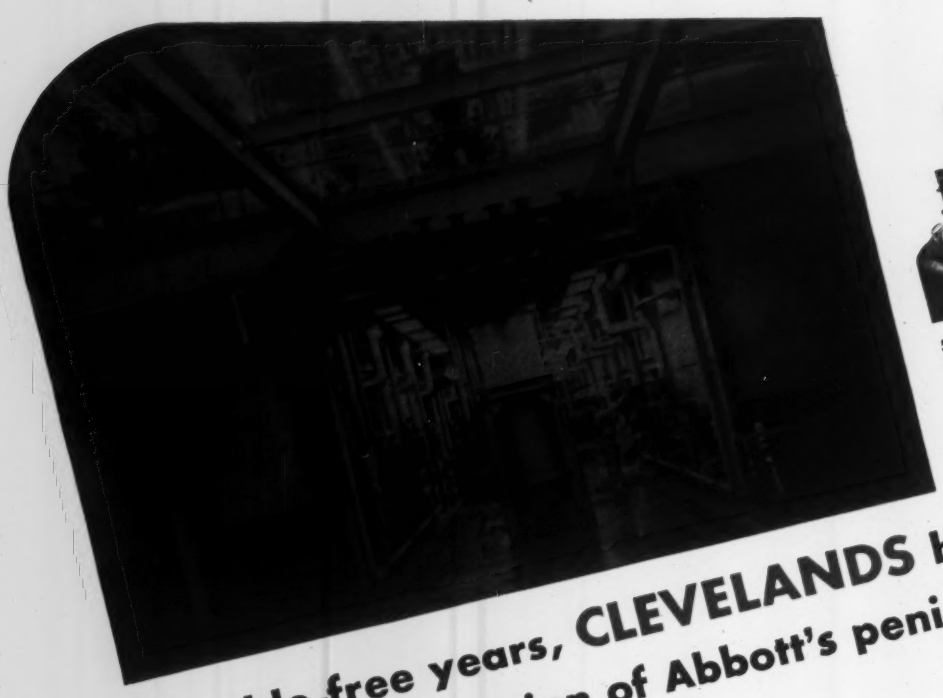
Sizes from
¼ in. to 2½ in.

*T.M. Reg. U.S. Pat. Off. — — Integral seat valves, with body and bonnet a single unit

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1228 West 145th Street, EAST CHICAGO, INDIANA



5,000 gallon fermenter with Cleveland horizontal unit mounted above it. At left is the fermentation room, with battery of 12 steel tanks, at Abbott Laboratories, North Chicago, Illinois.

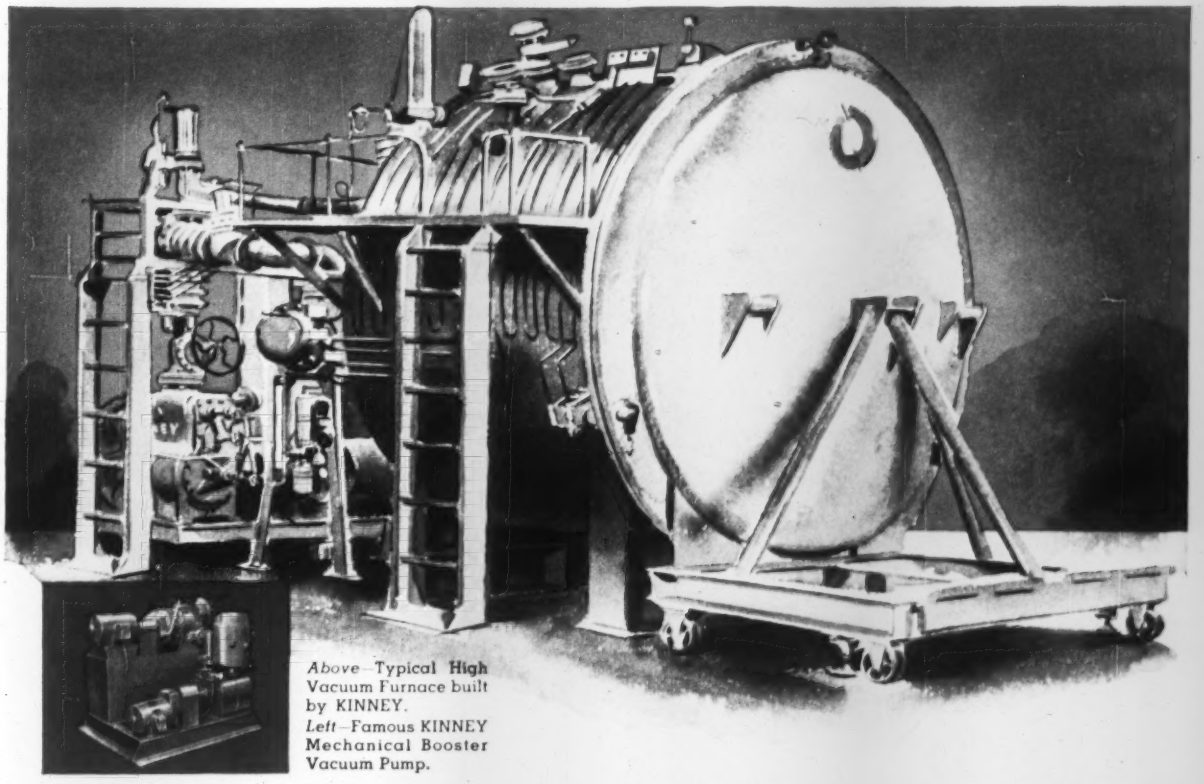
For 10 trouble-free years, CLEVELANDS have served in mass production of Abbott's penicillin

CONTINUOUS, uniform agitation of each batch is essential to proper processing of penicillin and other antibiotics. To insure uninterrupted, trouble-free operation at this leading pharmaceutical plant, Cleveland Worm Gear Speed Reducers were installed over ten years ago to drive the turbine impellers of a battery of 5,000 gallon fermenters.

In service continuously since 1946, these Cleveland drives have met every requirement. High yields have been the rule through the years. Only normal maintenance has been required. So far as life is concerned, the reducers are still "good as new".

Wherever trouble-free service and long life are a must in power transmission equipment, there your first choice is Cleveland. And there's a type and size for every need. Bulletin 145 shows the entire line of standard models, available when you need them. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.



Above—Typical High Vacuum Furnace built by KINNEY.
Left—Famous KINNEY Mechanical Booster Vacuum Pump.

For You—New Opportunities for Product Improvement through VACUUM METALLURGY

KINNEY MFG. DIVISION
Boston, Mass.

High Vacuum Mechanical Pumps, single stage, 13 to 780 cfm, pressures to .01 mm Hg; two stage, 2 to 46 cfm, pressures to .0002 mm Hg; Mechanical Booster Pumps, 30 to 5000 cfm, pressures to .0001 mm Hg. Rotary Liquid Handling Pumps to 3000 gpm.

VACUUM EQUIPMENT DIVISION
Camden, N. J.

Complete KINNEY Vacuum Systems—Vacuum Furnaces (Arc, Induction or Resistance), Evaporators, Optical Coaters and Metallizers, TV Tube Aluminizers; Oil Diffusion Pumps, Gages, Valves and Oils.

WATERTOWN DIVISION
Watertown, N. Y.

Railroad Air Brake equipment of all types; STRATOPOWER Hydraulic Pumps and Motors for Aircraft, to 5000 psi for operation to 400° F.

KALAMAZOO DIVISION
Kalamazoo, Mich.

HYDRECO Hydraulic equipment for industrial and mobile applications. Gear and Dual-Vane Pumps and Motors to 2000 psi, to 120 gpm, to 120 hp. Control Valves to 2000 psi and 150 gpm. Cylinders Telescopic, Single and Double-acting to 10" diameter, strokes to over 20 ft.

AURORA PUMP DIVISION
Aurora, Ill.

AURORA Centrifugal Pumps to 8500 gpm and 600 ft. heads. APCO Turbine type Pumps, 5 to 150 gpm, heads to 700 ft. Condensate Return Units 800 to 100,000 sq. ft. radiation.

The whole broad picture of metallurgy is undergoing dramatic change with NEW metals, NEW alloys and NEW qualities in conventional metals. Today, engineers and fabricators must "take a second look" because the list of unavailables is being drastically reduced. Many pure metals and alloys, heretofore too costly, are now economically practical. From humble Iron castings to Titanium, Vacuum Degassing is imparting new characteristics, properties and uses to hundreds of metals.

Now, there are KINNEY Vacuum Furnaces for melting, refining and sintering powdered metal parts in volume at temperatures exceeding 2000° Centigrade; furnaces for alloying, consolidating, brazing, annealing, welding and heat treating under High Vacuum or pressurized atmospheres of inert gas.

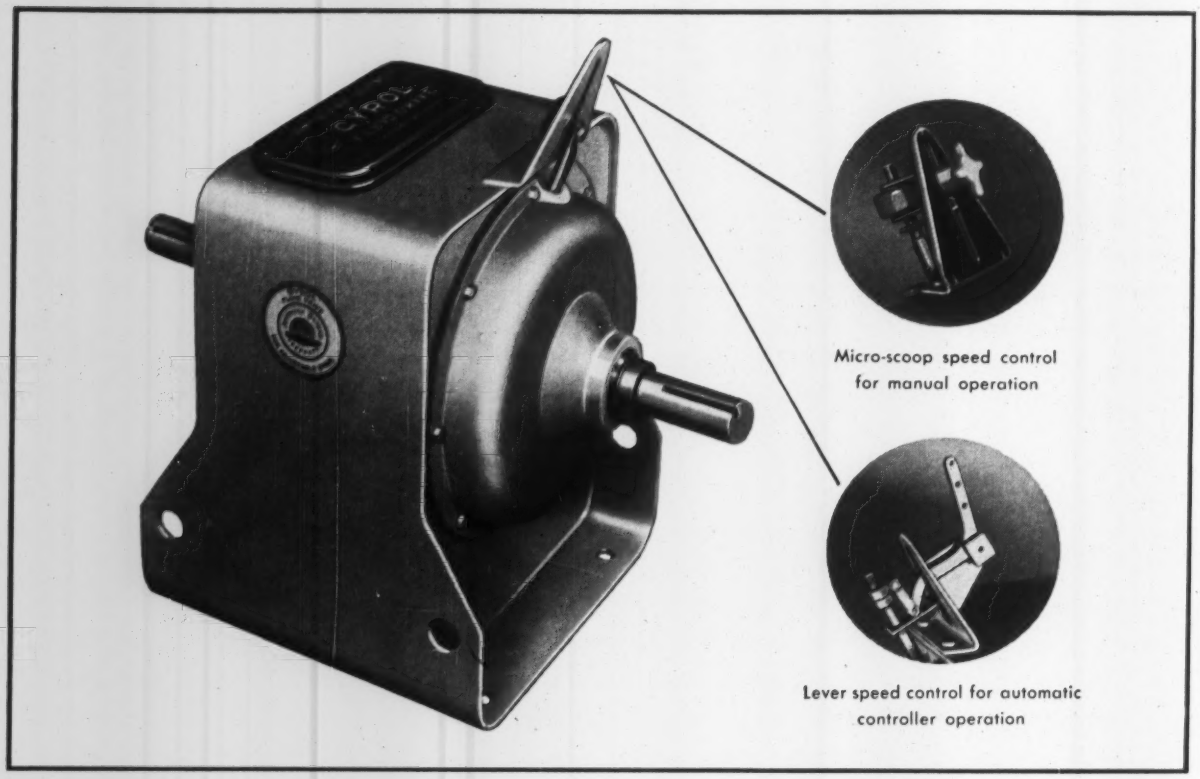
What this means to you is—a broad new horizon of product improvement, reduced rejects, predictable performance—and last, but not least, sound, profitable production.

The KINNEY Mfg. Division of The New York Air Brake Company has, for years, maintained an international reputation for leadership in the development of High Vacuum equipment. Here, High Vacuum "know-how" and Imaginative Engineering spark advanced type High Vacuum Pumps, Components and Completely Engineered Systems for the physicist, research technician and producers of Metals, Electrical and Electronic devices, Refrigeration and Air Conditioning equipment, Optical lenses and many Chemical and Pharmaceutical products.

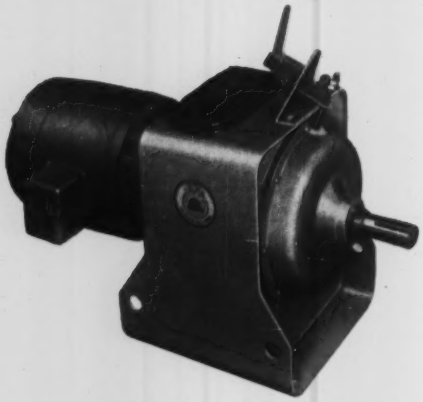
Write to Kinney Mfg. Division, 3529 Washington St., Boston 30, Mass. for Bulletin No. 1102A and further information on High Vacuum Furnaces.

THE NEW YORK AIR BRAKE COMPANY

230 PARK AVENUE • NEW YORK 17, N. Y.



American Blower *Gýrol*® Fluid Drives now available in lower horsepower ranges!



Type VS, Class 2 Gýrol Fluid Drives for 1- to 25-hp applications. Also available with flange-mounted motor, as shown.

Adaptable to either automatic or manual control, American Blower Type VS, Class 2 Gýrol Fluid Drives come in a complete range of new smaller sizes—1 hp to 25 hp, speeds to 3600 rpm—to satisfy your every power-transmission need!

These compact, self-contained units offer an answer to many industrial-drive problems because of their important benefits: adjustable, stepless speed control; full reversibility; 5 to 1 speed range; no-load starting; protection against shock; quiet operation.

For full information on the complete line of Type VS, Class 2 Gýrol Fluid Drives, 1-800 hp—or other designs to 12,000 hp—contact our nearest branch office. Or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

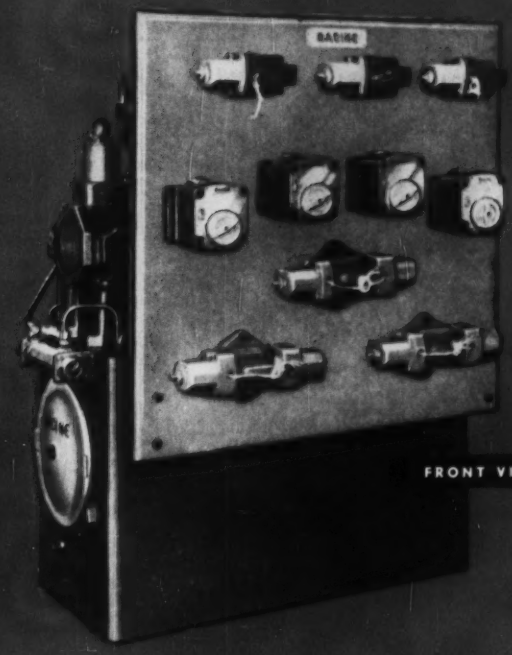
AMERICAN BLOWER

Division of AMERICAN-Standard

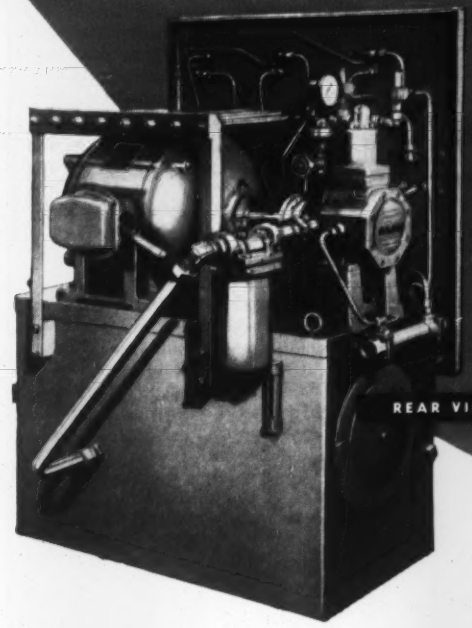
Let

RACINE

engineer your hydraulic needs



FRONT VIEW



REAR VIEW

A TYPICAL RACINE HYDRAULIC "POWER UNIT"

WHY RACINE FACTORY-ENGINEERED, FACTORY-ASSEMBLED *"HYDRAULIC POWER UNITS"* ARE BETTER FOR YOU!

1. Designed, engineered and built with Racine-made components to your specific machine operation needs
2. Compact — requiring a minimum of floor space
3. All components easily accessible for quick servicing
4. Complete and ready for immediate hook-up to your service lines
5. Control valves positioned on easily accessible, clearly designated control panel
6. Field sales and service representatives in all principal cities

Investigate RACINE'S *free* engineering service. Let Racine Hydraulic specialists relieve your engineering load. It will save you valuable time and money. Utilize this responsible single source of supply. Write us about your hydraulic projects. Your needs will receive prompt attention. No obligation.

RACINE — STANDARD FOR QUALITY AND PRECISION — RACINE HYDRAULICS & MACHINERY, INC.

NFPA NATIONAL FLUID POWER ASSOCIATION

Member

RACINE HYDRAULICS & MACHINERY, INC.

2076 Albert Street

RACINE, WISCONSIN

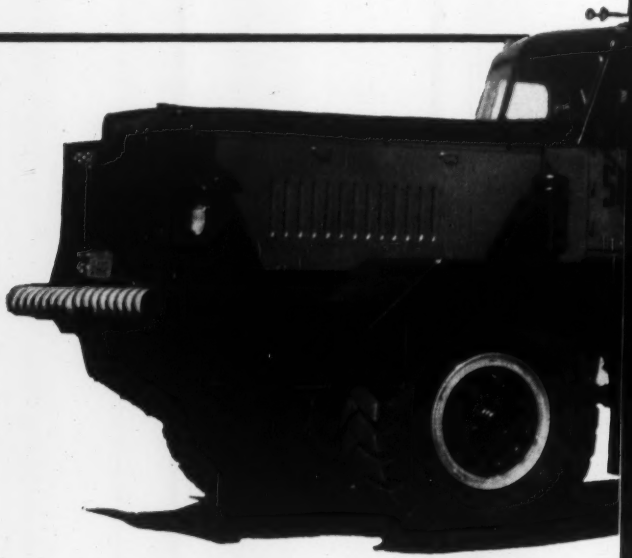
Meets high formability requirements —saves 24% weight

Here's a job that may surprise quite a few steel users accustomed to thinking of high strength steel as being "stiff" and therefore not readily formable. For in making these LP-gas containers, USS MAN-TEN Steel blanks ¼" thick are press-formed *cold* into seamless shells, 29" in diameter and 24" deep. Such an operation calls for a degree of formability that would be considered high even for carbon steel.

By taking advantage of this property, Pressed Steel Tank Co., Milwaukee, Wisc., was able to reduce the shell thickness of this Hacknøy container 24%, and at no increase in cost, produce a stronger, tougher and more durable container that is 102 lbs. lighter than when made of carbon steel. This saving in weight means easier handling in the shop and during installation, plus substantial savings in freight costs—both on the steel used and when finished containers are shipped.

Assures greater portability, prolongs life

In portable oil drilling rigs like this, every pound of weight saved is of vital importance. To keep weight as low as possible without sacrificing ruggedness, the Cardwell Mfg. Co., of Wichita, Kansas, has built the trailer frame and working platform of USS MAN-TEN Steel and reduced weight 6,000 lbs. as compared to structural carbon steel construction. In the 96-foot mast, which can be telescoped and folded down when the rig is moved, MAN-TEN Steel used in all the structural members reduces weight about 25%, and helps to keep moving costs down to a minimum. MAN-TEN Steel's superior strength and abrasion resistance, plus its high fatigue strength, also pay off by keeping the rig steadily on the job.



UNITED STATES STEEL
USS HIGH STRENGTH STEELS
1933 1957
24 YEARS OF PERFORMANCE

USS MAN-TEN Steel—the low cost way to build better performance into equipment like this

IN THE PAST 24 YEARS, USS MAN-TEN Steel has earned the high regard of design engineers—and for good reason.

Faced with the knotty problem of improving equipment, while at the same time keeping down its cost, they have found that with USS MAN-TEN Steel they not only could materially reduce weight—or greatly increase strength and durability—but often could do so at *lower* cost than with structural carbon steel.

For USS MAN-TEN Steel, although it costs only about 25% more, has a yield point at least one and one half times that of structural carbon steel. It has greater abrasion resistance. Its fatigue strength is about 40% higher. Its resistance to atmospheric corrosion is twice that of carbon steel. In addition, USS MAN-TEN Steel is more readily worked and welded than structural carbon steel of the same strength level.

Thus when MAN-TEN Steel is used in the same thickness as structural carbon steel, it will increase strength 50% at only about 25% increase in material cost. And when used in 20 to 25% thinner sections, MAN-TEN Steel construction, though lighter, may be designed for *both* greater strength and lower cost.

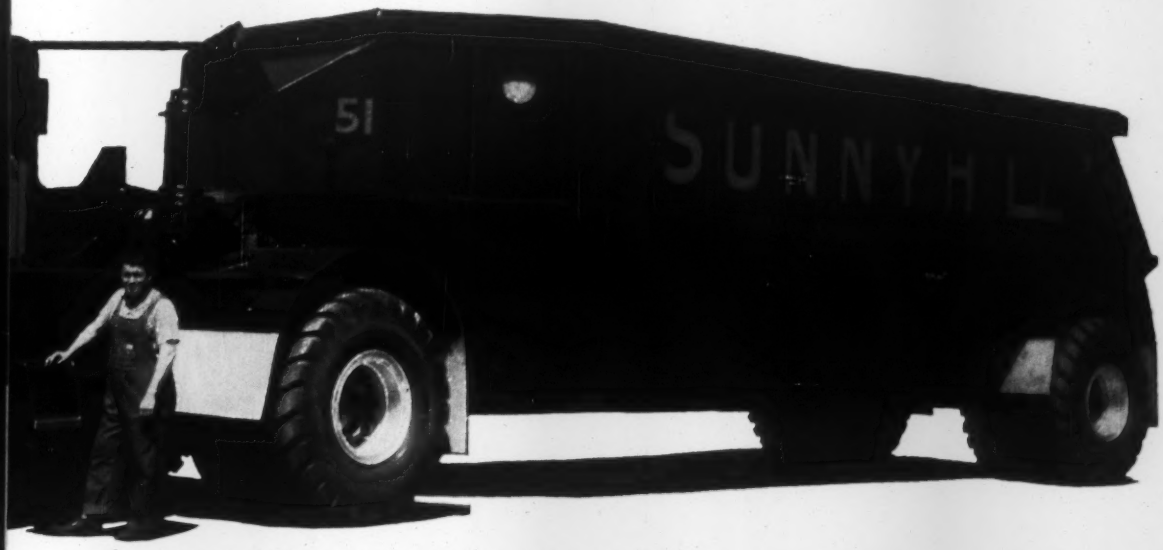
The increased working capacity, longer life and greater freedom from maintenance its use ensures are money-saving advantages that pay off BIG in customer satisfaction and increased salability.

To find out how you can incorporate USS MAN-TEN High Strength Steel in your designs most efficiently and economically, send for our 174-page "Design Manual for High Strength Steels." This authoritative book covers every facet of this important subject. For your free copy, write—*on your company letterhead*, giving your title or department—to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

Cuts weight 15%, increases payload capacity 15%

This 50-ton Dart coal hauler is a classic example of how USS MAN-TEN Steel can solve a difficult weight problem. Large trucks like this are generally designed right up to the limit of tire capacity. In other words, their size is largely determined by the maximum combined weight of truck and payload that the tires can safely carry. Thus the 15% reduction in body weight made possible by lighter MAN-TEN Steel construction, by lifting that much weight off the tires, enabled the designers to increase the payload capacity by a highly desirable 15% so that the truck is able to carry a huge 50-ton load on rough, off-road hauls without undue jeopardy to tire life.

Ten trucks like this, built by Dart Truck Company, Kansas City, Kansas, have been in use more than three years at Sunnyhill Coal Company's New Lexington, Ohio, workings. Each hauls an average 120,468 tons per year. To date, none has required repair of any kind. All are still in perfect condition.



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NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

USS, MAN-TEN, COR-TEN and TRI-TEN are registered trademarks of United States Steel

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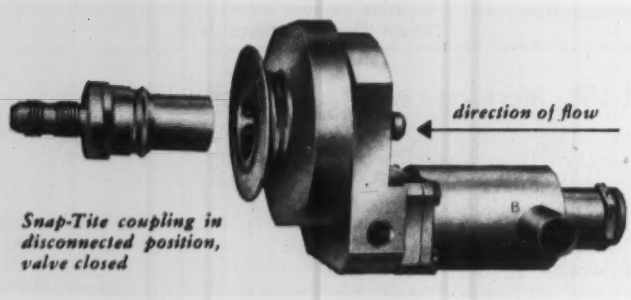
UNITED STATES STEEL

SNAP-TITE REMOTE CONTROL COUPLINGS FOR GUIDED MISSILES



Snap-Tite coupling in disconnected position, valve closed

Here is a specially designed Snap-Tite quick-connect, quick-disconnect coupling, ideal for use in missile-fueling systems. This unit is specifically designed to be manual-connected . . . can also be disconnected manually, or by use of an air-actuated remote control.

NOT A DROP SPILLED!

When the coupling is disconnected, it spills only that small amount of fluid which clings to the metal. The valves in both the coupler and nipple automatically shut off when disconnected, *with no leakage.*

NO AIR INCLUSION!

Coupling operation encloses only a minute amount of air.

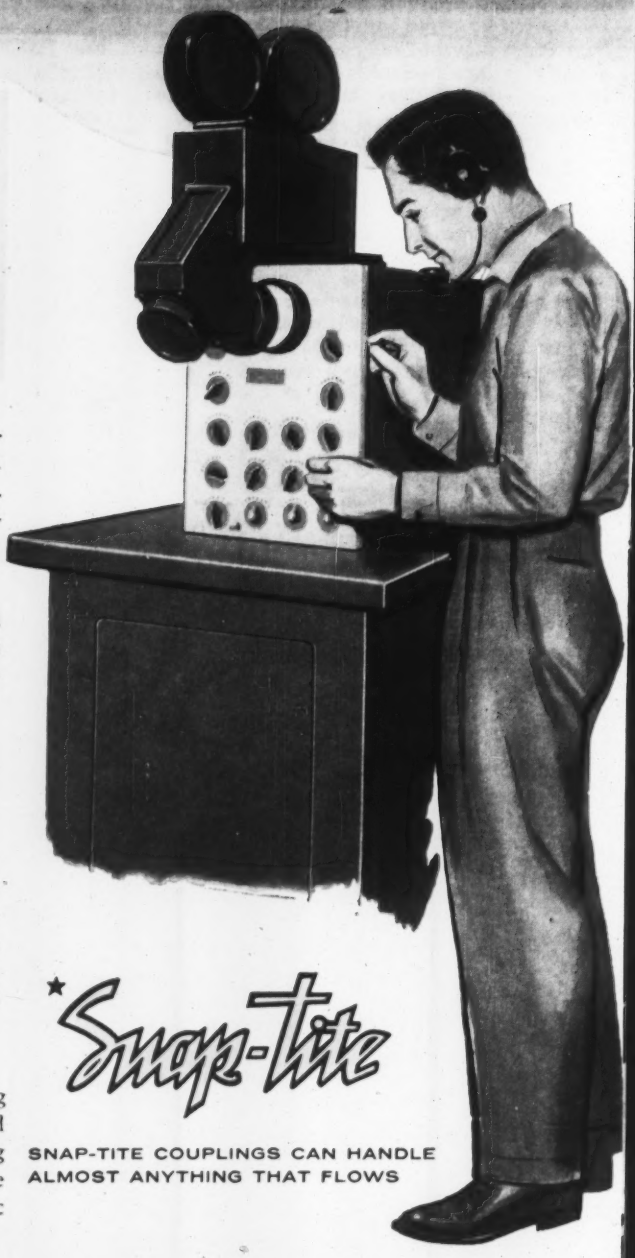
MINIMUM PRESSURE DROP!

Smooth, streamlined passages assure maximum flow.

Variations of this coupling, to meet your required specifications, can be furnished with the appropriate seals to handle liquified gasses, exotic fuels, and a large variety of fluids with working pressures up to 3,000 PSI and temperatures from −300°F to +400°F. Units have been designed up to and including 5″ size.

STANDARD COUPLINGS, TOO!

Your coupling needs might not be as critical as the coupling shown here, but you can be sure, when buying standard Snap-Tite couplings, that the same outstanding engineering and manufacturing skills are basic throughout the Snap-Tite line. Write for complete catalog . . . or describe your specific coupling problems. Snap-Tite, Inc., Union City Pa.

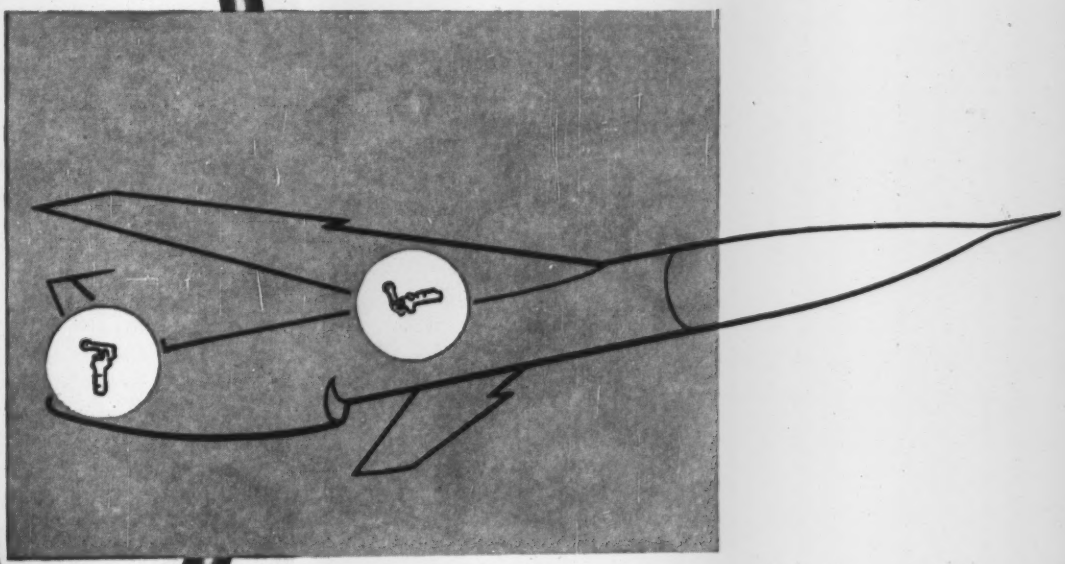


★Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

. . . To blast an INVADER . . . .

LINEAR KEEPS THE "GO" IN PROTECTIVE MISSILES with Jet-Age "O" Rings



Modern warfare weapons . . . that guard and protect . . . are highly complex devices. They must be dependable for instantaneous service—even after an unpredictable shelf-life.

In rocket and missile warfare use, "O" rings will be subjected to nitrogen, JP-4, ethylene oxide, hydrogen-peroxide, alcohol, liquid oxygen, fuming nitric acid, and other destructive environments. "O" rings are used in the servo-systems for flight control of guided missiles, and must withstand extremes in temperatures and the destructive actions of synthetic fluids.

LINEAR's experience in the design and production of precision "O" rings —of the most modern elastomers—has given them the ability to provide dependable seals for the most critical requirements.

When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance . . .

and be sure to specify LINEAR "O" Rings for prototype or production.

"PERFECTION IN RUBBER"

LINEAR

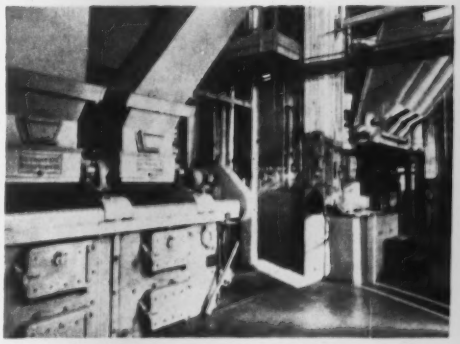
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA 35, PA

Carlisle Tire

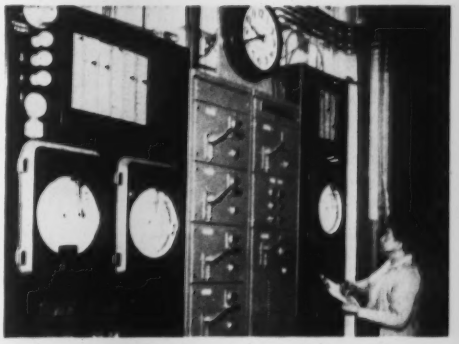
takes fuel costs for a ride

With increased fuel efficiency, Carlisle Tire and Rubber burns coal . . . holds costs to minimum while upping production 20%

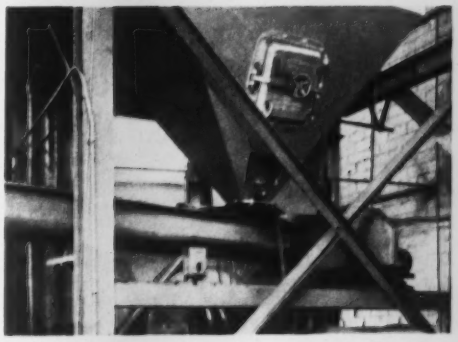
At the Carlisle Tire and Rubber Division of Carlisle Corp., Carlisle, Pa., the steam produced by the power plant is used primarily for processing. As production of bicycle tires, inner tubes and other rubber products increased, the firm's engineering department decided to boost steam capacity with modern coal-burning facilities. Coal was used on the basis of cost—25% less than the nearest competitive fuel. The result has been a dependable steam supply, cleanliness of operation and a jump in operating efficiency. Today the plant consumes the same tonnage of coal as before modernization although production has increased 20%!



Firing aisle of Carlisle's power plant. Left foreground is new 20,000 lbs./hr. boiler by E. Keeler Co., fired by Detroit Rotostokers. In the rear is an Erie City Water Tube Boiler (equipped with Erie City Spreader Stokers), used as stand-by unit.



Close-up of control panel, by Hagan Corp. These controls—regulating furnace draft, steam flow, air flow, flue gas temperature, stoker control—constitute a complete, automatic combustion control system.



Fly ash is collected by this Prat-Daniel Mechanical Precipitator. Fly ash is gravity-fed from the hopper (at top of photograph) into completely-enclosed screw conveyor which moves it cleanly to the disposal point.

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, as in the case of Carlisle, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar on the average. Today's automatic equipment pares labor costs and eliminates smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send the coupon below for our case history booklet, complete with data sheets. You'll find it informative.

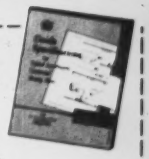
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—will effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D.C.

The Bituminous Coal Institute now has available a free booklet, "Guide Specifications for Typical Low-Pressure Commercial Heating Plant," containing specifications, drawings and tables on all aspects of a typical heating plant. Send in this coupon for your copy.



Please send me: ☐ Guide Specifications booklet ☐ Case history booklet

Name .....

Title .....

Company .....

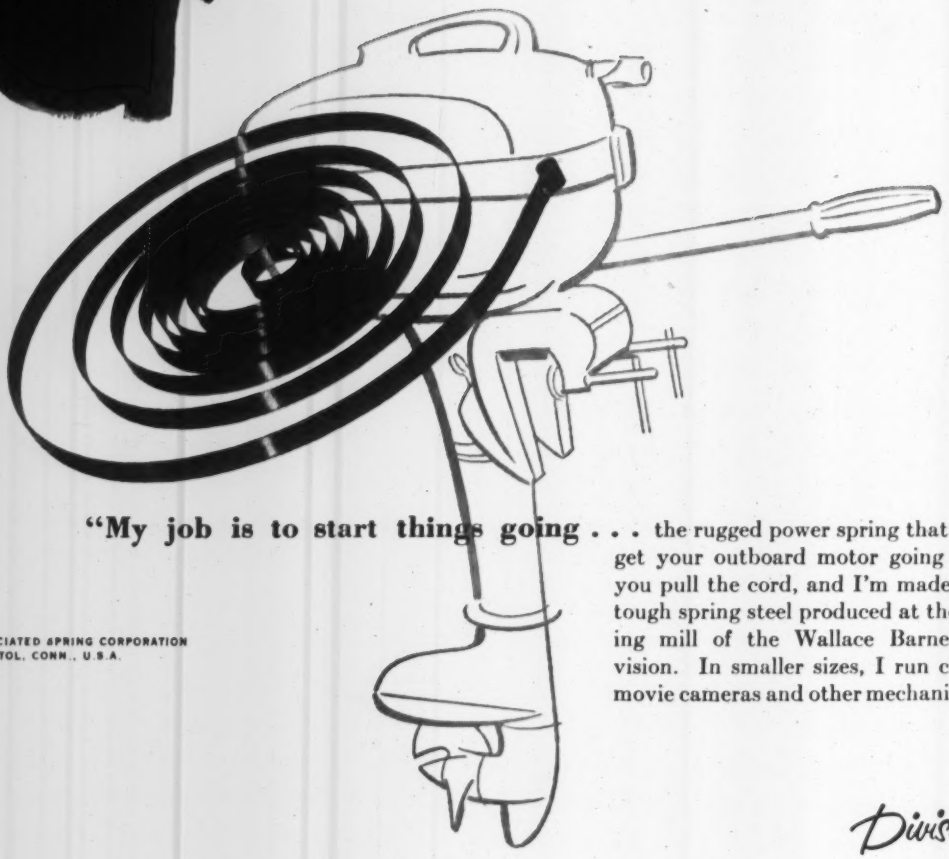
Address .....

City ..... Zone ..... State .....

Interviews...

"I'm a life-giving spring . . .

. . . just an ordinary-looking coiled spring, made of stainless steel, I perform my work in blood transfusion apparatus—always dependable—like every A.S.C. spring."



"My job is to start things going . . . the rugged power spring that helps get your outboard motor going when you pull the cord, and I'm made from tough spring steel produced at the rolling mill of the Wallace Barnes Division. In smaller sizes, I run clocks, movie cameras and other mechanisms."

5730
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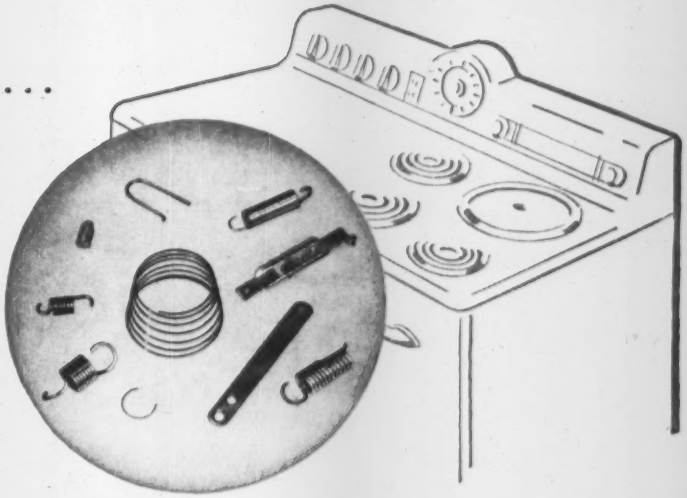
BRISTOL, CONN., U.S.A.

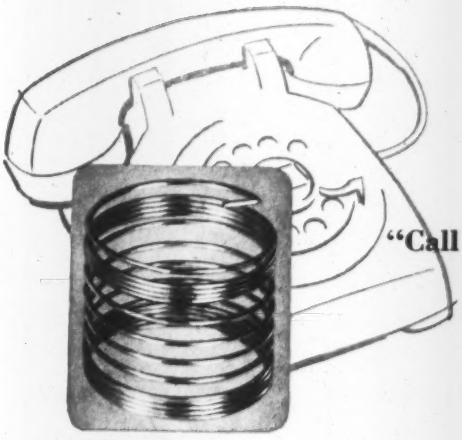
Divisions of

with Successful Springs

"We'll time your eggs . . .
or turn off the current . . .

. . . we're the family of coil and flat springs that control the timing of your electric stove, dishwasher, clothes washer and dryer. Divisions of A.S.C. make all types of instrument springs."

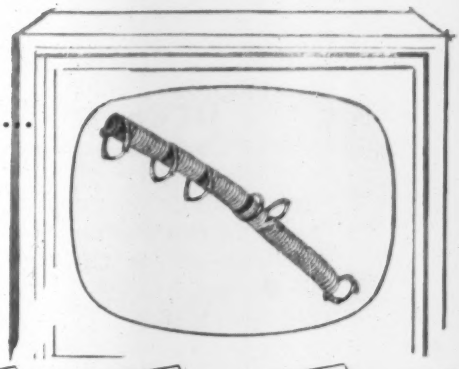




"Call me up sometime . . .

. . . and when your finger dials a Division of Associated Spring Corporation, I'm the spring that returns the dial after each number selection—always at your service."

"Tune me in on T V. . . .



. . . I'm not really a spring—but A.S.C. engineers figured how to make tuning coils like me with special coatings on a spring winder. *If you need a spring—or a thing that looks like a spring—see a Division of Associated Spring Corporation."*

Send for Pamphlet "Designing Springs for Performance"

DIVISIONS OF ASSOCIATED SPRING CORPORATION
COAST TO COAST

WALLACE BARNES COMPANY, BRISTOL, CONNECTICUT
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RAYMOND Manufacturing COMPANY, CORRY, PENNSYLVANIA
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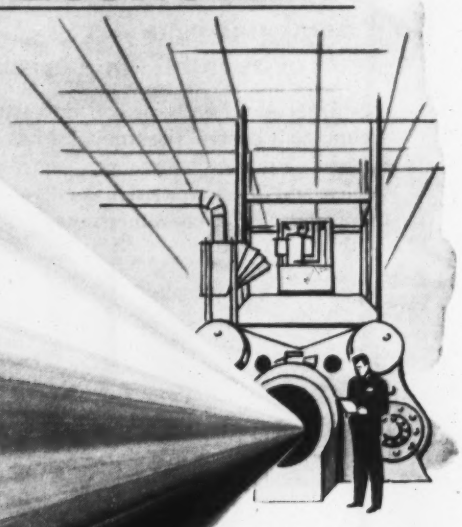
ASSOCIATED SPRING CORPORATION

GENERAL OFFICES: BRISTOL, CONNECTICUT

FOR YEARS OF PIPE ECONOMY...



THIS EXTRUDED HEAVY WALL

PROTECTS

against severest heat, pressure and corrosion

Here is High Integrity pipe for the toughest applications in the power, petroleum, chemical and other industries. Extruded from any ferrous alloy in lengths up to 50 feet or more, and with virtually any wall thickness, this pipe from the Curtiss-Wright Metals Processing Division provides increased on-the-job life, long-term economy, elimination of down time – not just for months, but for years to come. Extruded to specification under tremendous one-push pressures from the Division's giant 12,000-ton horizontal steel extrusion press, Curtiss-Wright Heavy Wall Pipe is of uniform high strength and has high resistance to pressure, heat and corrosion. Write today for information on both your standard and special requirements.

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METALS PROCESSING DIVISION

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CORPORATION • BUFFALO, N. Y.

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About the Cost of Living . . . with Steam Traps

WHEN YOU specify steam traps, what could possibly be more important than *the cost of living with them* — production cost . . . steam cost . . . downtime cost . . . repair cost.

No steam traps manufactured have ever provided greater equipment operating efficiency or lower trap maintenance cost than Armstrongs.

Consider the experiences of these companies:

"30% Greater Output from platen presses since installing Armstrong Traps" — rubber processor.

"$8000 Annual Fuel Saving since replacing 600 traps with Armstrong" — metal processor.

"30% Less Downtime for repairs with Armstrong Traps" — food processor.

"$25,000 Trap Maintenance Saving every year since installing 4000 Armstrong Traps" — major chemical plant.

You may well ask, "Can there really be so big a difference in steam trap performance?" The answer is: These are typical experiences of people who have compared Armstrong trap performance — not for a month or a year, but over periods of 2, 5 and even 10 years or more.

The Armstrong trap has certain fundamental advantages, including:

No Steam Loss — the valve is always water-sealed.

Large air-venting capacity — air is automatically discharged along with condensate.

Long-life parts — hardened chrome steel valve and seat — all other parts corrosion-resistant stainless. Absolutely nothing to stick, bind, clog or collapse. Not affected by ordinary dirt and scale.

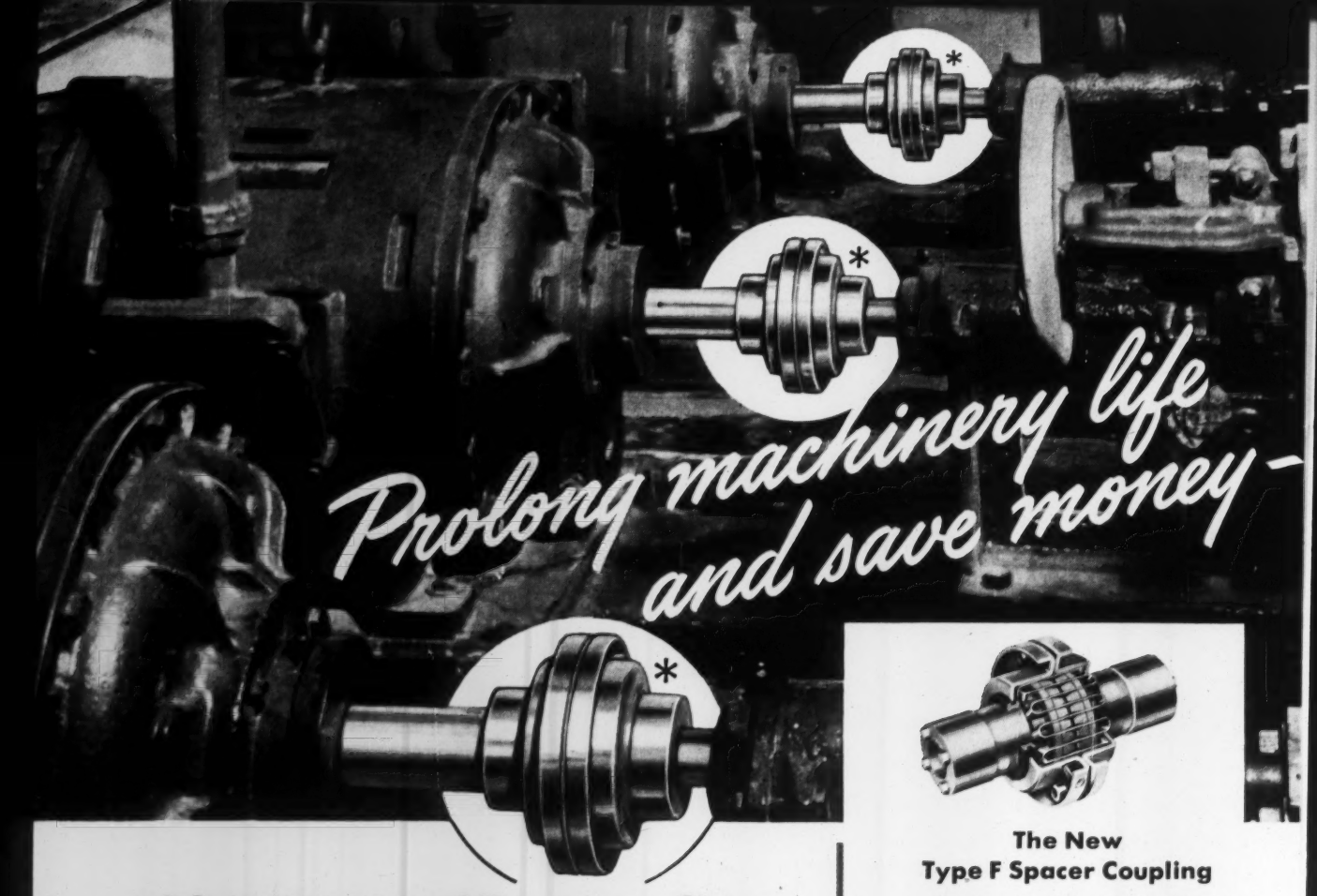
Unconditionally guaranteed to satisfy. It takes an awfully good product to carry such a guarantee.

Steam traps can have such a big effect on plant operating efficiency, they are worth more than casual consideration. Let your Armstrong Factory Representative answer your questions. There is no obligation. Call him or write:

ARMSTRONG MACHINE WORKS
8946 Maple Street • Three Rivers, Mich.

Do you have "The Steam Trap Book"? — 44 pages of useful data on trap sizing, calculation of condensate loads, installation and maintenance. Free on request.

ARMSTRONG STEAM TRAPS



Prolong machinery life and save money—

with FALK Steelflex Couplings

Ever since the first Falk Steelflex Coupling was designed and built, we have firmly held to these beliefs:

1. A coupling, to give fullest value, must do more than merely *connect* driving and driven machinery—it must *protect* the machinery and prolong its life.

2. A coupling, to be truly flexible, must overcome the effects of shock and vibration, as well as shaft misalignment.

Proof of the soundness of those beliefs is furnished by the record. More than one million Falk Steelflex Couplings have been used on every conceivable type of industrial application . . . giving trouble-free service, providing maximum protection to connected machinery.

* A single basic type—the famous Type F—fills 90% of all industrial application needs. It is versatile, efficient and economical. And—it is always available from factory, field or distributor stocks, in a wide range of sizes.

Write to Department 247 for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

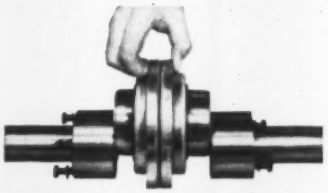
...a good name in industry

The New Type F Spacer Coupling

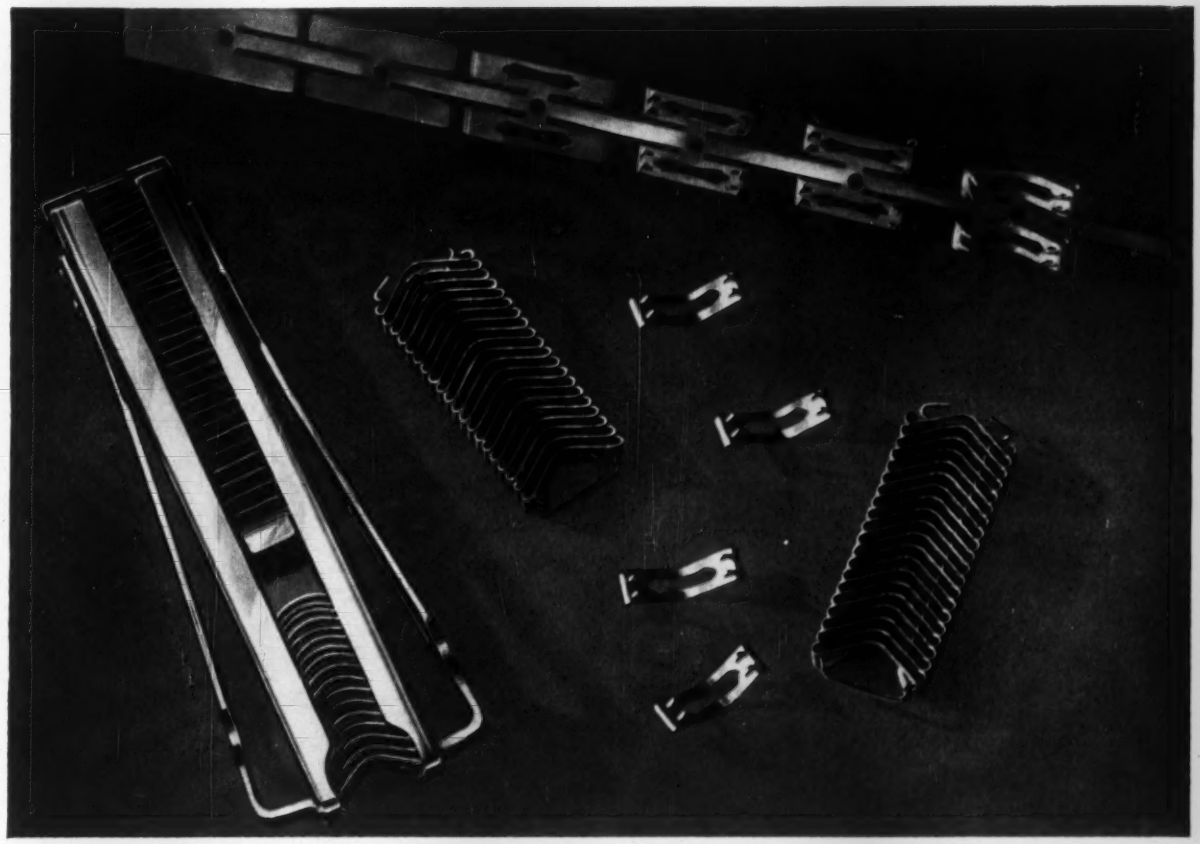
Here is a Steelflex coupling specially designed to permit fast, easy installation and removal in horizontal and vertical applications where it is impracticable to move the connected units—or where a space-gap (up to 12 in.) is necessary.

Like all Steelflex couplings, the Type F Spacer gives long, trouble-free service and maximum 3-way protection for connected machinery: it provides torsional resilience to reduce shock and vibration; it accommodates parallel or angular shaft misalignment; it allows free (or limited) end float.

An outstanding feature of the Steelflex Spacer is that it can be installed or removed in one piece (see photo below); no dismantling or servicing of the coupling is required. Pump assemblies can be disconnected and removed without disassembling the coupling, without exposing working parts.



The Steelflex Spacer coupling is prelubricated at the Factory and can be installed, or removed and reinstalled, without disturbing the lubricant—a highly desirable feature.



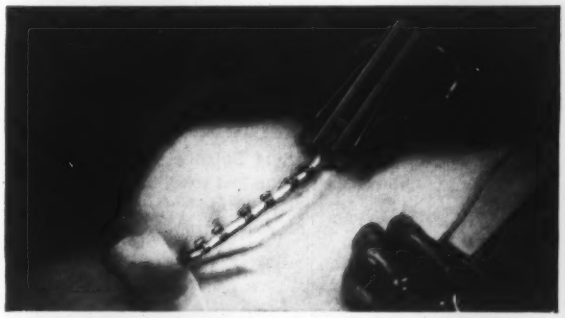
Above: The various steps in forming Autoclips® from Anaconda 18% Nickel Silver strip, .637" wide by .013" thick. Below are individual Autoclips and those mounted in wire holders ready for insertion in Autoclip Applier, at left. Exclusive wholesale distributor for Autoclip is Clay-Adams, Inc., New York City. ***Below, left:*** Autoclips being used to attach skin towel to edges of incision.

Anaconda Technical Service helped in

Selecting the exact Nickel Silver strip for this surgical clip

THE PROBLEM: The Technical Oil Tool Corporation, Los Angeles, developed Autoclip, an automatic magazine-type clip and applier to close wounds or incisions faster and easier. Selecting the right metal for the clip was the problem. A certain amount of tension was required to hold the wound edges together during healing, with the least amount of damage to tissues. In addition, the clip had to open easily for painless removal. The metal should be easy to form, and retain sharp, die-cut edges.

THE SOLUTION: After several unsuccessful attempts with various metals, sample clips of the required gage were made of Nickel Silver. These silvery white copper-alloys have excellent resistance to corrosion in service or in storage and have been time-tested for surgical instruments and equipment. Technical specialists of The American Brass Company suggested Nickel Silver, 18%-719—one of four standard Anaconda Nickel Silver Alloys—as the one best suited to meet all the requirements including tension, formability, clean edges and sharp points.



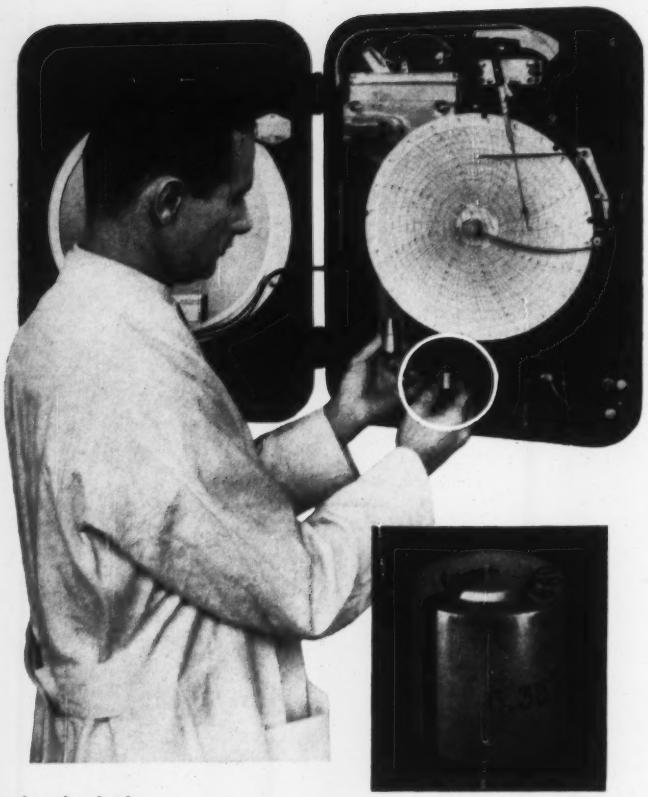
FREE TECHNICAL SERVICE: Metallurgists and technical specialists in The American Brass Company, through their day-to-day work with a great variety of metal problems, offer a tremendous breadth of experience. And this experience is at your disposal—to help you select the exact alloy, form, temper for your job. Call your American Brass Company representative, or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA®
COPPER, BRASS, BRONZE and NICKEL SILVER
Made by The American Brass Company

HAGAN RING BALANCE FEATURES—NO. 3

CHECK CALIBRATION OR CHANGE RANGE IN MINUTES

without water columns—without disconnecting meter from line



TIME SAVER—This shows how easily a Ring Balance can be checked. Note there are no two-story water columns—one man is doing the job—and the meter has not been disconnected from the line. In fact, Ring Balance can be checked at full static pressure if desirable.

The check weight is factory calibrated against a micrometer type manometer, and its equivalent in inches of water column is stamped on the side. The serial number of the meter to which it belongs is also stamped on the collar. A full set of calibrated weights is supplied with each meter.

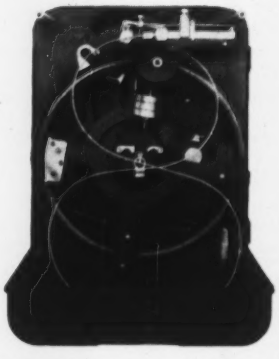
The calibration of any Hagan Ring Balance meter can be checked—in minutes—by simply hanging the appropriate weight on the check weight rod. Similarly, range change over a seven to one differential range can be done with equal speed and accuracy.

In terms of instrument technician's time, you can easily figure how much this one feature of the Ring Balance will save you. And, you don't have to take a busy pipefitter away from other work to break connections.

Ask your Hagan engineer to show you how easily range change and calibration checks can be made, using only the set of check weights supplied with each meter. Ask him, too, to explain some of these other outstanding features of the Hagan Ring Balance:

1. High sensitivity at low flows due to unique range calibration system. Full scale deflection at ½" WC.
2. Safe operation with rings rated at 2,500, 6,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eye-droppers.
4. Interchangeable ring assemblies for full scale ranges from 0.5" WC to 560" WC. Adjustment on any one ring over a seven to one differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.



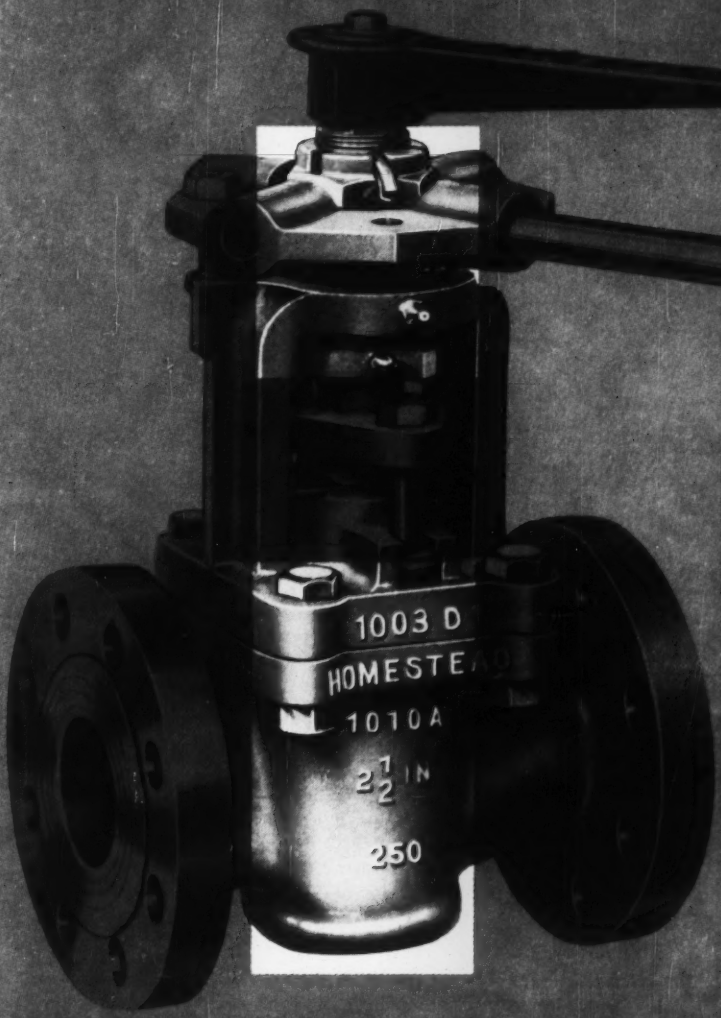
Rear view of Ring Balance with cover plates removed. Here the test weights are in position on the test weight rod. Note accessibility of all parts for easy adjustment.

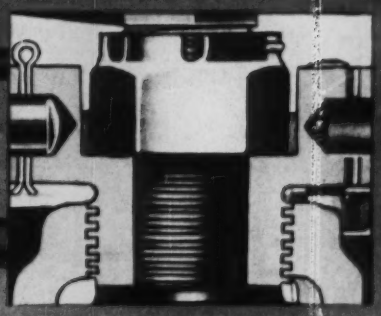
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON

In the spots that count... Homestead Valves are

STICK-PROOF





Built-in lever and screw affords instant operation

Seating pressure is mechanically relieved for easy turning

TROUBLE-FREE SERVICE is assured under all fluid, temperature and pressure conditions by the exclusive design of Homestead Lever-Seald Valves.

Instant stick-proof operation is guaranteed by a built-in lever and screw which mechanically relieves seating pressure. This controlled relief of pressure is only sufficient to overcome friction and to permit the plug to turn freely. What's more, all operating parts are protected from the damaging effects of corrosive or erosive service conditions and are completely weatherproof.

Write today for fully detailed Reference Book 39—Section 3. See for yourself how Homestead Lever-Seald Valves can solve your problems on high temperature, pressure or corrosive services.

h
v

HOMESTEAD VALVE MANUFACTURING COMPANY
P. O. Box A-38 Coraopolis, Pa.

Bailey Meters and Controls for Combustion, Feed Water, Steam Temperature and Condensate at Moores Park Station, City of Lansing, Michigan.

How Bailey makes steam operating duties a pleasure—

Fingertip Controls, convenient indicators and trend recorders make steam control room operating duties a pleasure. You get this bonus for your operators when you specify Bailey Meters and Controls.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs.

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A133-1

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

For fractional to 40 hp drives . . .

BOSTON Gear SPROCKETS and CHAIN

FROM STOCK . . . at Factory Prices

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ANY TYPE OR SIZE YOU NEED

.81" to 38.20" P.D. SPROCKETS, iron and steel, for single ROLLER CHAIN

1.92" to 26.74" P.D. SPROCKETS, iron and steel, for double ROLLER CHAIN

¼" to 2½" P. ROLLER CHAIN single, double, and triple

1.94" to 12.74" P.D. SPROCKETS, iron and steel, for BLOCK CHAIN

⅛" to ½" w. BLOCK CHAIN

.37" to 6.07" P.D. SPROCKETS, bronze and steel, for LADDER CHAIN

.185" to .353" P. LADDER CHAIN brass and steel

Save machining time

SHOLD-A-GRIP interchangeable tapered SPROCKETS and BUSHINGS

2.09" to 23.88" P.D. SPROCKETS adaptable with tapered BUSHINGS to shaft sizes ½" to 3" by 16ths

BORED-TO-SIZE ready-to-install SPROCKET PINIONS

Complete with keyway and setscrew. ⅜" through 1" P., in 76 tooth sizes, with 321 stock bores

You get BOSTON GEAR top-rated quality and lasting economy. You save time and expense when you buy from local stock — *at factory prices.* Be cost-wise — standardize. Boston Gear Works, 66 Hayward St., Quincy 71, Mass.

CALL YOUR BOSTON Gear DISTRIBUTOR

For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

7124 "OFF-THE-SHELF" TRANSMISSION PRODUCTS **FROM STOCK** — AT FACTORY PRICES — ASK FOR CATALOG

Stock Gears • Sprockets and Chain • Speed Reducers • Bearings • Pillow Blocks • Couplings

...an even Quieter Silent Service

Engineer at Electric Boat Division uses G-R Vibration Meter and Vibration Analyzer to determine degree of dynamic balance of new Vaneaxial Blower. Sound-Level Meter and Octave-Band Noise Analyzer (furthest from operator) measure airborne sound level and frequency distribution of sound, respectively. G-R Strobotac (at lower right on seismic mass) conveniently measures fan speed without imposing drag or otherwise affecting operation.

Submarine noise must be kept to a bare minimum, as the very survival of the Silent Service depends on its ability to avoid detection. Spent air must be replaced with reconditioned air . . . but, ventilating fans make noise.

To minimize detection through radiated noises, and in particular to meet the critical requirements of the nuclear submarine, the Electric Boat Division of General Dynamics Corporation has developed an improved vaneaxial blower featuring slotted-blade airfoils that provide boundary-layer control. These blades offer distinct advantages. Losses due to turbulence and blade friction are significantly reduced, making possible smaller fan size and mass. This results in less noise and vibration. One such unit for submarine application rotates at one-half the speed of a similar-sized conventional unit, but delivers the same flow and pressure, with a substantial reduction in structure-borne vibration and in airborne noise.

General Radio sound and vibration measuring instruments were used throughout the investigations leading to the development of this fan. The equipment's ease of operation and completely self-contained, portable packaging proved particularly useful. Complete and dependable measurements could be made at each stage of development. This well integrated line of G-R instruments has long been an indispensable tool in the hands of those who work to make the Navy strong in our nation's defense.

GENERAL RADIO Company

. . . a Complete Line of Sound and Vibration Measuring Instruments.

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1182 Los Altos Ave., Los Altos, Calif. **SAN FRANCISCO** 6605 W North Ave., Oak Park, Ill. **CHICAGO**

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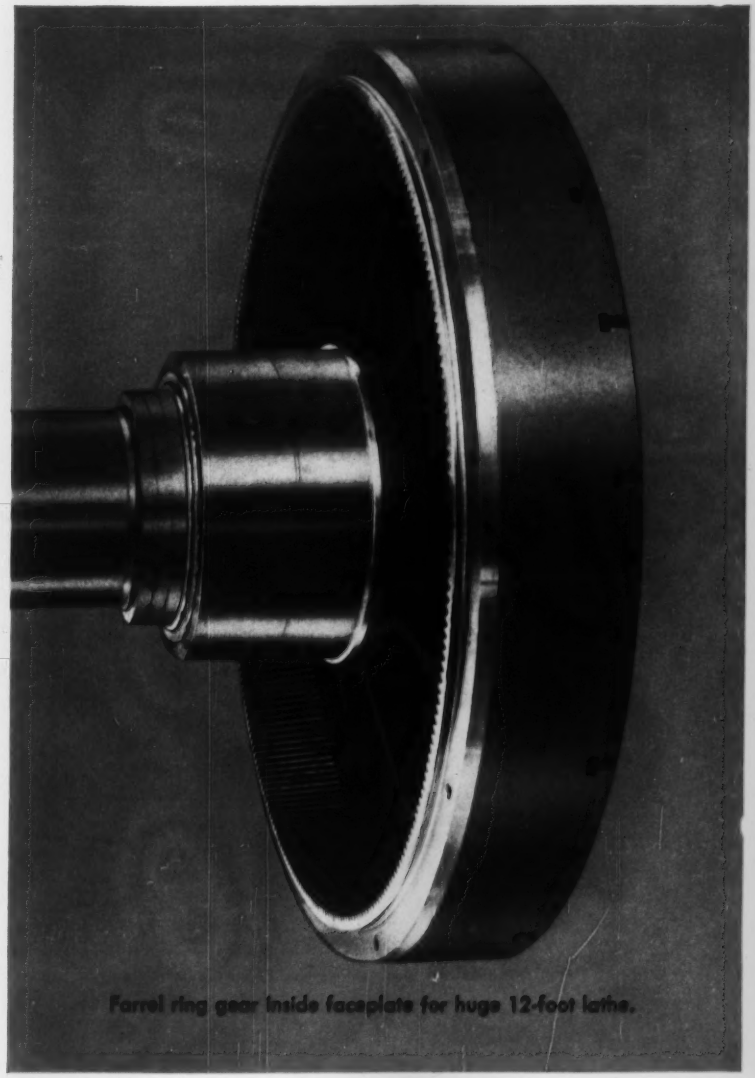
Write for the "Sound Bulletin."

All G-R Products are now covered by a *2-Year Warranty*

LARGE RING GEARS



Farrel ring gear inside faceplate for huge 12-foot lathe.

designed and built to your requirements

At Farrel, quality gears come in large packages. One example is the single-helical internal gear shown here in a 12-foot diameter, lathe faceplate. Designed to assure a smooth, vibration-free drive at relatively high speeds for the heavy work handled, the gear was precision-generated by the Farrel-Sykes method—a process that assures extreme accuracy of tooth spacing.

Farrel precision-generated internal gears are available with either single helical or spur teeth in sizes up to 23 feet blank diameter.

Farrel also makes external gears of the continuous-tooth herringbone, single-helical and spur types, in any size up to 23 feet diameter, for any power capacity or application.

Whatever your gear requirements may be, you can depend on Farrel's many years of gear engineering and manufacturing experience and complete production facilities.

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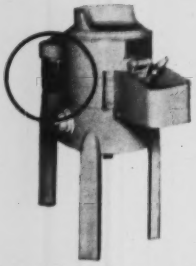
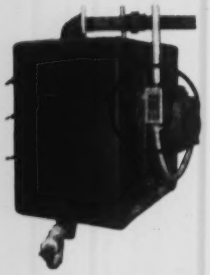
Farrel-Birmingham ®

FB-1124

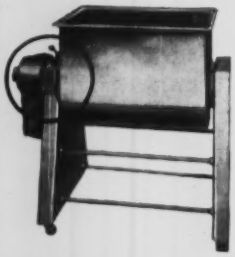
Townsend impact riveter protected by an Allen-Bradley Bulletin 600 starter.



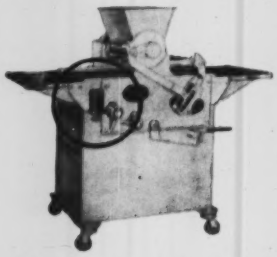
Gifford-Wood vegetable peeler with an Allen-Bradley Bulletin 600 starter.



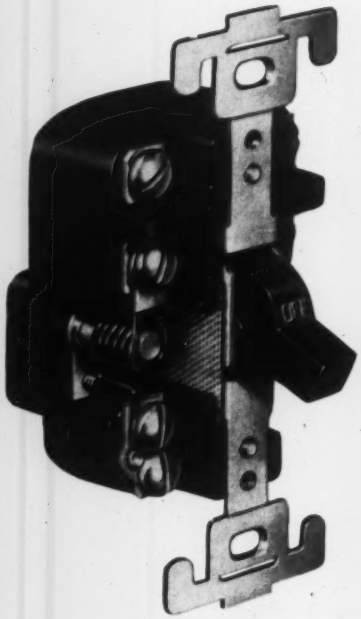
Unit space heater protected by an Allen-Bradley Bulletin 600 starter.



Kleen-Kut meat mixer has a ¾ hp motor and an A-B Bulletin 600 starter.



Triumph cookie dropper is protected by an Allen-Bradley Bulletin 600 starter.



LOW COST QUALITY MANUAL STARTERS
....for motors of 1 hp or less

Many small machine tools, restaurant equipment, fans and blowers, space heaters, etc., are operated by fractional horsepower motors. But even though the motors are small and relatively inexpensive, a motor burnout may disrupt important production schedules and, therefore, prove to be a costly accident.

Play safe—equip all of your small motor drives with Allen-Bradley Bulletin 600 starters. They have a built-in solder pot thermal overload breaker which remains accurate and dependable. It is low cost safety and production insurance.

Write for Bulletin 600, please.

Allen-Bradley Co.
1308 S. Second Street
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AB

In Canada—
Allen-Bradley Canada Ltd.
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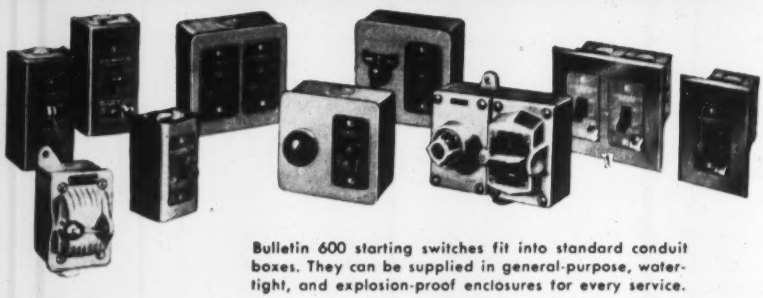
ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY



Bulletin 600 starting switches fit into standard conduit boxes. They can be supplied in general-purpose, watertight, and explosion-proof enclosures for every service.

OILITE
IN AN AUTOMATIC WASHER HELPS BUILD CUSTOMER SATISFACTION -YET COSTS NO MORE
OILITE bronze agitator shaft bearing
OILITE bronze upper center post bearing
OILITE bronze rubber-mounted lower center post bearing
OILITE bronze thrust washers (2)
OILITE bronze pulley bearing
OILITE bronze thrust bearing
OILITE bronze water pump bearing
Photos courtesy Whirlpool-Seeger Corporation St. Joseph, Michigan
Another cost-saving application of Amplex Powder Metallurgy

Quality is a *must* for trouble free operation, continued customer satisfaction. And quality depends upon the excellence of every part, every component. For many years Whirlpool-Seeger has used OILITE center post bearings, agitator shaft bearings, water pump bearings and pulley bearings in their automatic washers. Whirlpool-Seeger uses these and other OILITE parts for very good reasons.

First of all, the manufacturer knows OILITE heavy-duty bronze bearings will meet specifications. Chrysler-Amplex precision production assures him OILITE bearings capable of carrying their loads safely, surely and quietly.

Then too, Chrysler-Amplex plant and facilities—largest and most complete of any in the metal powder fabrication industry—promises on-time deliveries in any quantity.

Moreover, in using OILITE bearings the manufacturer selects a product his customers know and respect for superior engineering.

Finally, this manufacturer, like a great many others, finds OILITE bearings—despite all their advantages—cost no more.

Chrysler-Amplex representatives and dealers are located in principal cities in United States and Canada. Let the nearby representative help you. Find him in the yellow section of your telephone directory under—"Bearings—OILITE."

A CHRYSLER OILITE PRODUCT

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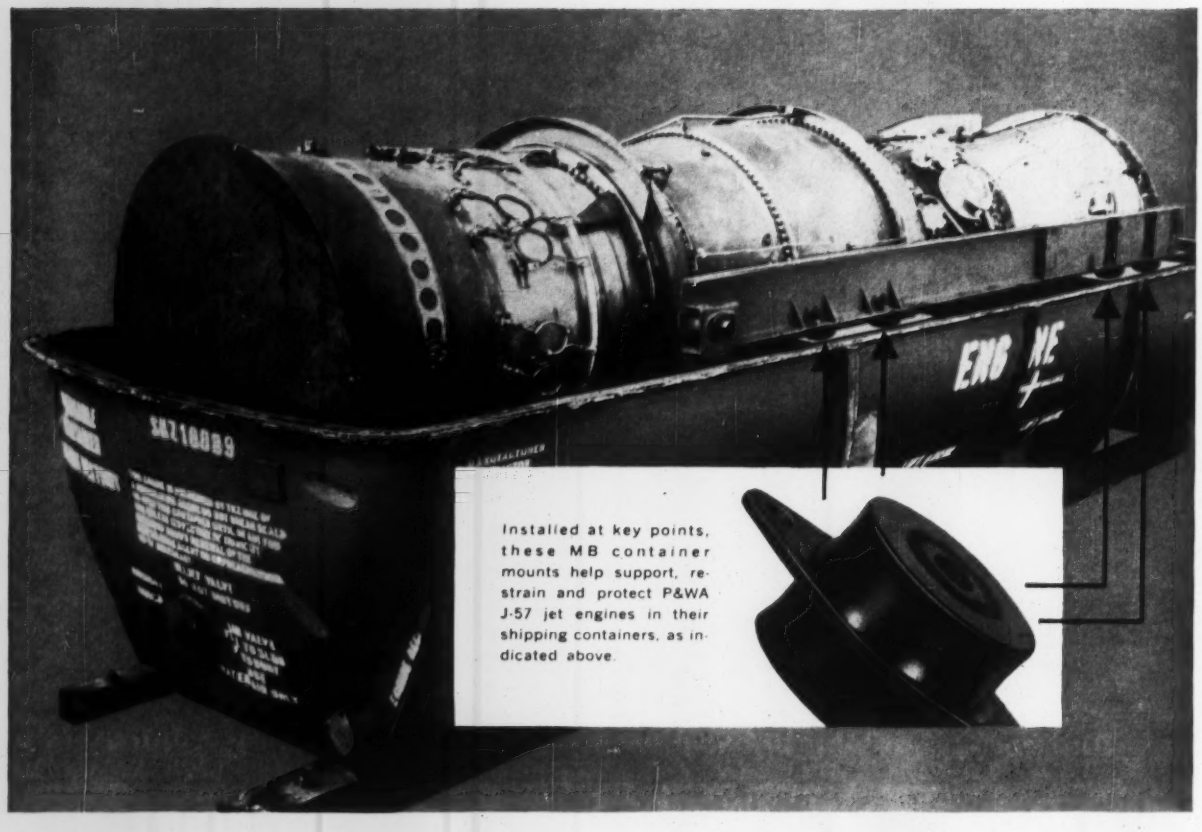
BEARINGS • FINISHED MACHINED PARTS • PERMANENT METAL FILTERS • FRICTION UNITS • FERROUS AND NON-FERROUS METALS

MB mounts restrain "canned" jet engines


Installed at key points, these MB container mounts help support, restrain and protect P&WA J-57 jet engines in their shipping containers, as indicated above.

Jet engines can experience vibration and shock problems before ever seeing service. It happens during transportation and handling, when they're in their shipping cans.

So special MB shock mounts are used to help protect P&WA J-57 engines in their containers. These units satisfy two important yet different performance requirements. They'll safely restrain the displacement and maximum "g" of the engine should the container be dropped even 3 feet. At the same time, they provide the cushioned mass with a natural frequency different from frequencies encountered in transportation, thereby avoiding resonance and consequent build-up of vibratory amplitudes.

MB concentrates on mounts which start where ordinary units have to give up. Various mounts have been developed which, while available as *standard* units, are actually in the *special performance* class. Perhaps we can work out a modification of one to solve *your* particular vibration problem. Send for Bulletin 616A.

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A Division of Textron Inc.
1074 State Street
New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION . . . TO EXCITE IT . . . TO MEASURE IT.

ANNOUNCING!

VICKERS New ¼" Temperature and Pressure Compensated FLOW CONTROL VALVE

ANOTHER VICKERS FIRST

FOR OPERATING PRESSURES UP TO 2000 psi

For years the Machine Tool Industry has been asking for a combination Temperature and Pressure Compensated Flow Control Valve to insure CONSTANT FEED RATES. Now for the first time it is available as a production unit at a reasonable price.

Check THESE EXCLUSIVE FEATURES that mean Optimum Tool Life and Better Work Finish:

☑ **TEMPERATURE COMPENSATED**
Constant feed rates all day long with same throttle setting because throttle automatically compensates for changes in oil temperature. The compensator mechanism is simple in design and durable.

☑ **PRESSURE COMPENSATED**
Constant feed rate throughout entire cycle because built-in pressure hydrostat automatically compensates for load changes.

☑ **SINGLE THROTTLE COMPLETE RANGE ADJUSTMENT**
Greater flexibility because valve is adjustable within entire flow range of 5 to 1000 cubic inches per minute.

☑ **REVERSE FREE FLOW AS STANDARD FEATURE**
A standard feature which permits reverse free flow (up to 1400 cu. in. per min.) from outlet to inlet port by-passing control elements.

☑ **TAMPER-PROOF ADJUSTMENT**
Retension of original feed rate is assured because a set screw prevents inadvertent throttle movement and a cover over the set screw can be locked in place.

☑ **INTERCHANGEABLE**
This new valve replaces 12 previous models and it is interchangeable with all of them, also the drain connection is eliminated on the new valve to simplify piping.

☑ **GREATER ECONOMY**
No need to stock several valves for wide range of flow rates. Drain connection is eliminated, piping costs are reduced.

☑ **MAXIMUM RELIABILITY AND ACCURACY**
Design of temperature and pressure control components assures maximum circuit reliability and extreme accuracy of feed through a range of 5 to 1000 cubic inches per minute.

FOR ADDITIONAL INFORMATION SEND FOR I-195040 7945

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Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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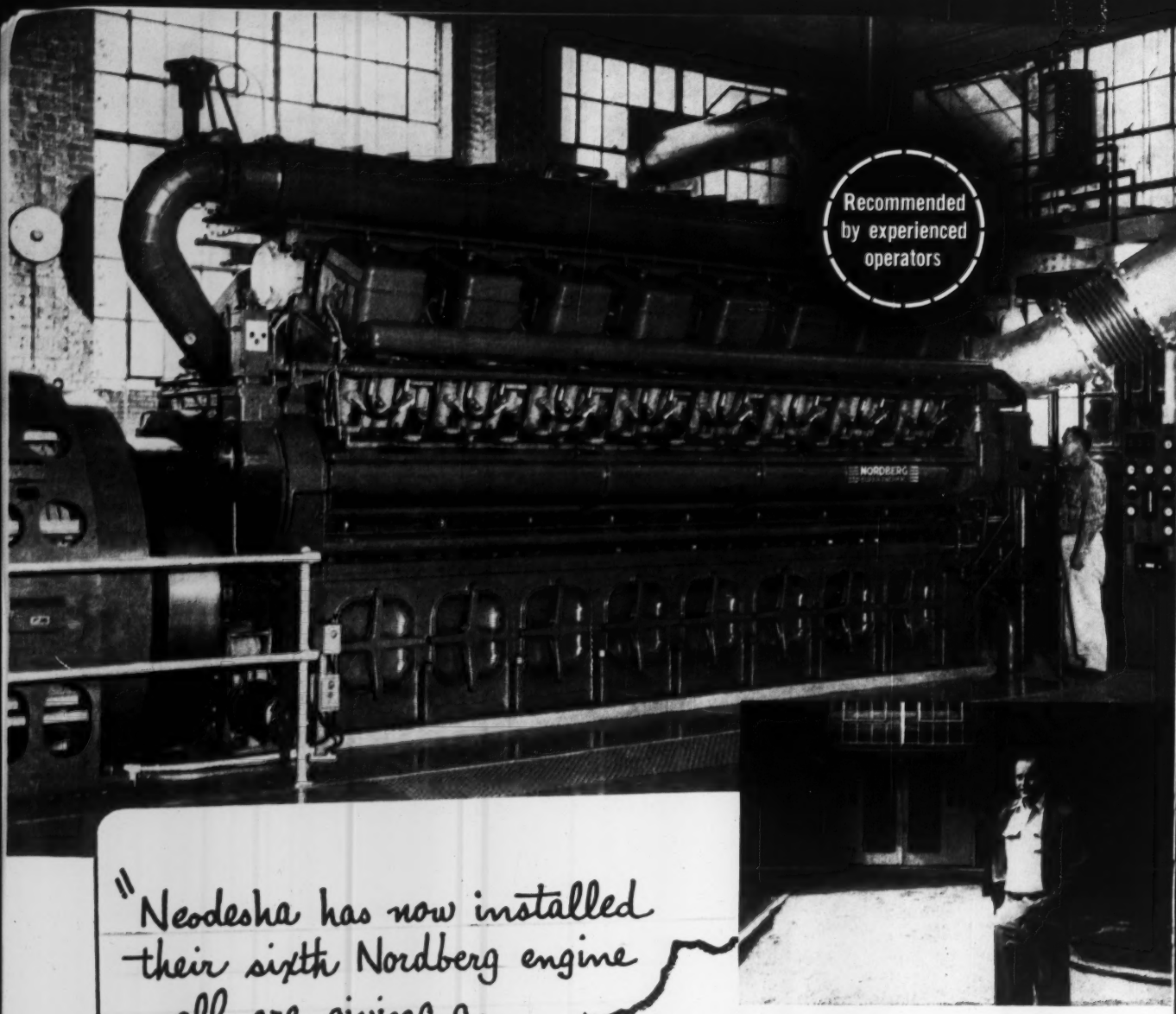
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



"Neodesha has now installed their sixth Nordberg engine ...all are giving a good account of themselves..."

...says Mr. Everett Powell,
Superintendent,
City of Neodesha, Kansas

Mr. Powell writes: "*The City of Neodesha has now installed their sixth Nordberg engine since 1922—all are giving a good account of themselves. Our newest, a 3150 B.H.P. Nordberg V-16 Supairthermal Duafuel unit, has been operating very satisfactory and we expect the same excellent service as recorded by our prior installed 1750 B.H.P. Duafuel unit. Our recent overhaul on this 1750 B.H.P. unit showed that rings and bearings still did not need replacement after 40,000 hours.*"

Here, then, are more reasons why Nordberg engines are recommended by experienced power plant operators . . . more reasons why there are so many *repeat* orders for Nordberg Diesel, Duafuel®, and Spark-Ignition Gas engines. Next time consult Nordberg on your power study . . . builders of a full range of engine sizes from 600 to over 12,000 hp. *NORDBERG MFG. CO., Milwaukee, Wisconsin.*

Installation Data:

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1946—Installed Nordberg 1620 hp engine.

1952—Installed Nordberg 1750 hp engine.

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NORDBERG

DIESEL • DUAFUEL® AND SPARK IGNITION GAS ENGINES

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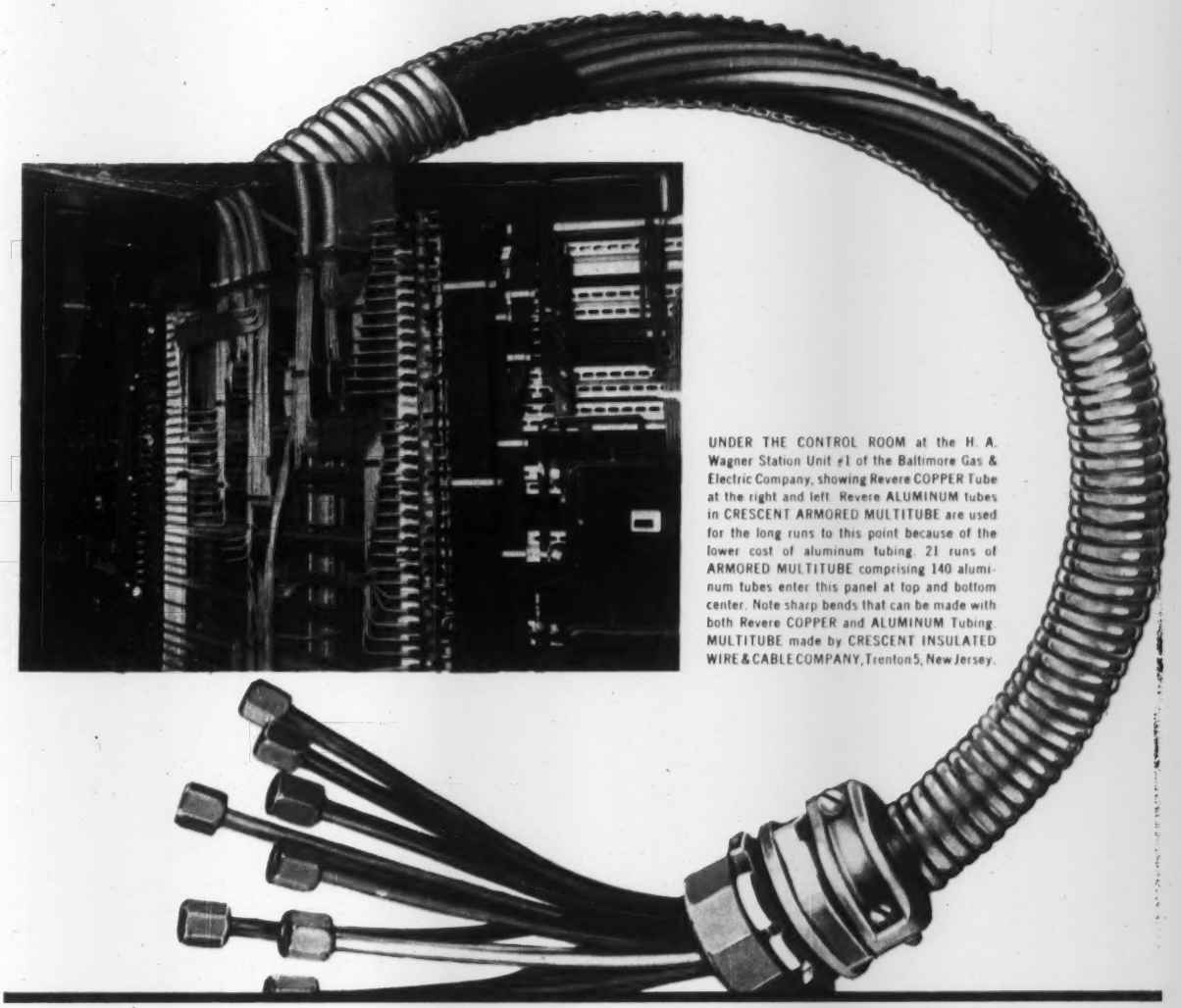


UNDER THE CONTROL ROOM at the H. A. Wagner Station Unit #1 of the Baltimore Gas & Electric Company, showing Revere COPPER Tube at the right and left. Revere ALUMINUM tubes in CRESCENT ARMORED MULTITUBE are used for the long runs to this point because of the lower cost of aluminum tubing. 21 runs of ARMORED MULTITUBE comprising 140 aluminum tubes enter this panel at top and bottom center. Note sharp bends that can be made with both Revere COPPER and ALUMINUM Tubing. MULTITUBE made by CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton 5, New Jersey.

CRESCENT relies on REVERE

for dependable performance of its instrumentation and control tubing

REPORTS, "NOT ONE FAILURE."

The dependable performance of Revere Copper Tube in Crescent Armored Multitube*, ever since its inception, has led the CRESCENT INSULATED WIRE & CABLE COMPANY to fill its aluminum tube needs with Revere also.

In fact, Crescent, since it first started using Revere Copper Tube in 1953, reports not a single failure. And that's mighty important in instrumentation and control tubing service where utilities, chemical processing, petroleum, paper and similar industries can't afford the luxury of process failures.

Crescent Multitube, using either Revere Copper or Aluminum Tube, or both in combination, offers a completely protected installation for permanence, lower original installation cost, lower maintenance and a saving of time, space and money.

Crescent Armored Multitube consists of a group of Revere Copper or Aluminum Tubes, twisted together in cable form, protected by a flexible interlocked galvanized steel armor. Constructions are available employing plastic sheaths in combination with the armor for corrosive locations. Section of cabled tube pictured shows how Copper or Aluminum Tubes are encased inside the Armored Multitube. As many as 37 tubes of ¼" OD can be cabled in lengths up to 1,000 ft.

For details on Multitube write Crescent and for uniform quality copper and aluminum tube, speedily delivered, see the nearest Revere Sales Office.

*Reg. Trademark

REVERE COPPER AND BRASS INCORPORATED

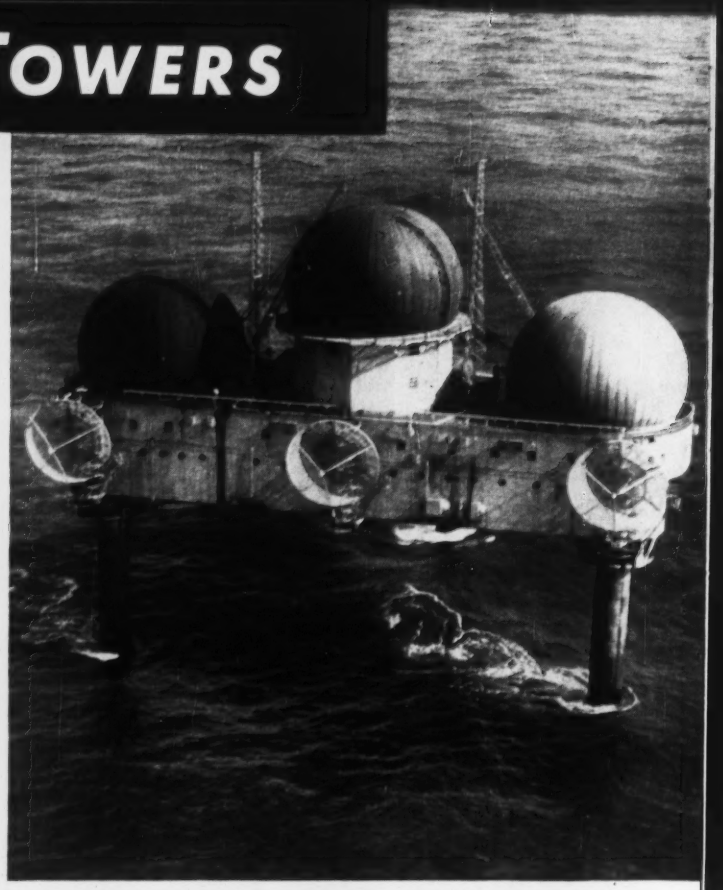
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER • BRASS • REVERE • ALUMINUM

ON TEXAS TOWERS



Wallace Process Piping Co., Inc.

Used

MIDWEST

WELDING FITTINGS

Among the unique installations for preservation of peace are the early warning radar "Texas Towers" off the Atlantic Coast. These artificial islands stilted to the ocean floor keep watch by radar. As is true of many defense projects, Midwest Welding Fittings played a significant part on Texas Towers.

Midwest Welding Fittings are found on unusual and in critical as well as routine jobs because of exceptional quality maintained by rigid standards of manufacture. Quality control is always above and beyond code requirements.

Whatever the piping job, you will find it to your advantage to use Midwest Welding Fittings. The many benefits you get by specifying "Midwest" are shown in Catalog 54. Ask your distributor or write us for a copy.

MIDWEST PIPING COMPANY, INC.

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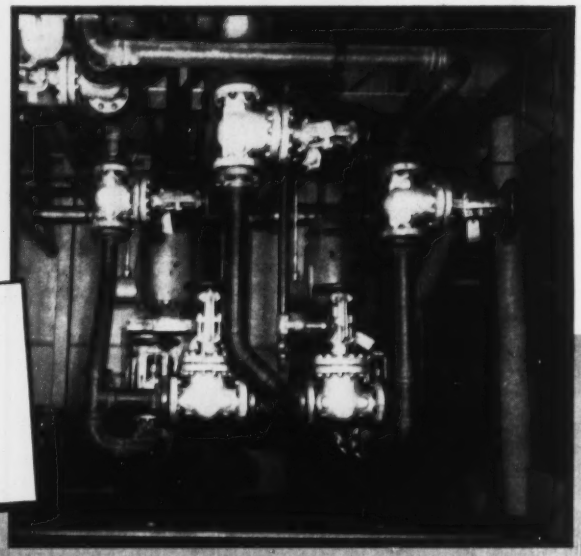
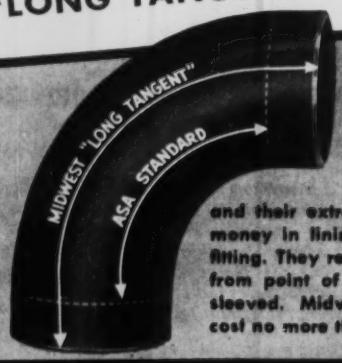


MONEY SAVED With MIDWEST "LONG TANGENT" ELBOWS

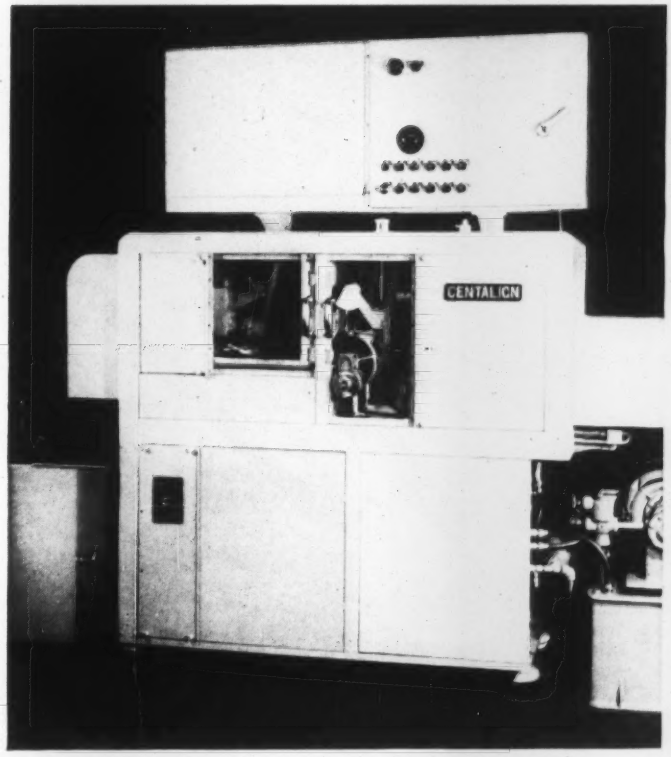


Here are the important advantages of Midwest "Long Tangents": They save pipe. They often eliminate short nipples and their extra welds. They save time and money in lining up and clamping pipe and fitting. They remove the circumferential weld from point of maximum stress and can be sleeved. Midwest "Long Tangent" Elbows cost no more than other elbows.

Piping on two Texas Towers was installed by Wallace Process Piping Co., Inc., as subcontractors to Steers Morrison Knudsen and Continental Copper & Steel Industries, Inc. All welding fittings were supplied by Midwest through Central Jersey Supply Co. The many advantages of Midwest "Long Tangent" Elbows were an important factor in the selection of Midwest fittings for this critical work.

7901

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



Bryant "Centalign" internal grinder for finishing tapered bearing races. Built for lower cost with welded steel.

LESS WEIGHT... GREATER CAPACITY

Costs cut with welded steel

By taking full advantage of the superior strength and rigidity of steel, engineers of the Bryant Chucking Grinder Company have reduced the cost of this machine base.

Other significant benefits are:

- **Reduced Weight**—26% less.
- **Increased Capacity**—swing of machine increased from 9 to 12 inches.
- **Closer Tolerances**—average size variations from piece to piece on bearing races lowered from 0.00040 to 0.00015 inches and surface finish improved from 21 to 10 micro-inches rms.

These advantages are typical of those being realized by machine tool manufacturers who have designed their product for welded steel. You can attain similar benefits. The Lincoln Electric Company stands ready to assist with your redesign projects.

DESIGN HELPS for engineers and designers

"Procedure Handbook of Arc Welding Design and Practice" new 11th edition, 1300 pages, over 1100 illustrations. Has 240 page section on Machine Design. Price only $3.00 postpaid in U.S.A. $3.50 elsewhere.

Machine Design Seminars conducted regularly at our plant in Cleveland.

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Write to us for full details.

LINCOLN

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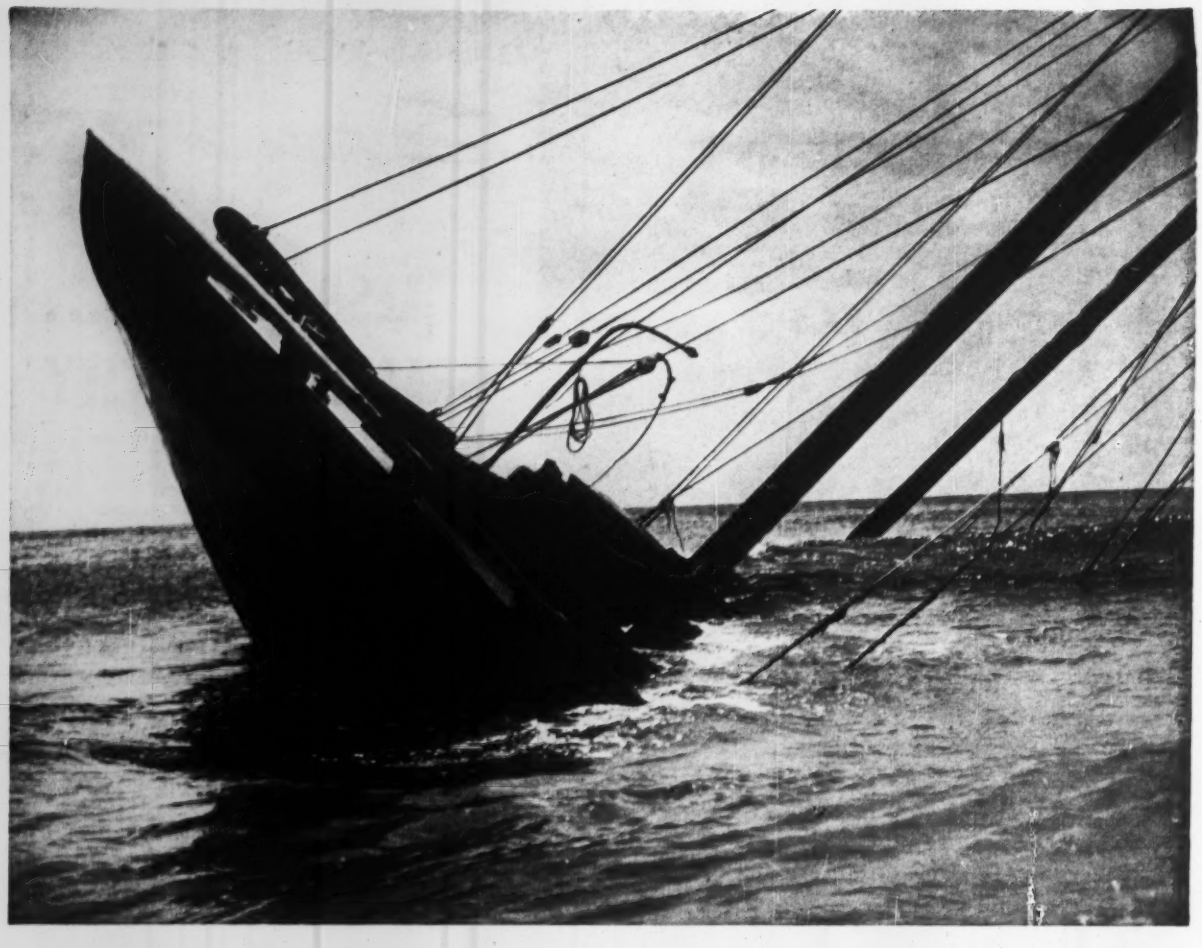
The World's Largest Manufacturer of Arc Welding Equipment

When welded steel is three times stronger than iron

Has 2½ times the rigidity

Yet costs ⅓ as much per pound

WHY use anything but welded steel for machine bases?



A timely warning from nickel might have made a difference

The sea seldom offers a clue to what lurks beneath its surface. But man can find out.

He beams sound waves to the ocean floor. And listens as they come bouncing back. The technique is called "echo sounding." It's the modern way to probe the depths . . . to map sea-bottom contour . . . to locate schools of fish . . to avoid reefs and other underwater obstructions.

One of the principal types of instruments (the fathometer) used in echo sounding depends on nickel for sending and receiving the telltale waves. Nickel, you see, has a rather unusual physical property called *magnetostriction* . . .

This simply means that it changes dimensions when exposed to a magnetic field. And it can be made to contract and return to its original dimensions rapidly enough to generate powerful sound waves.

Of course, nickel has other useful properties. Strength and toughness, for example. Resistance to corrosion. Electrical conductivity. But *magnetostriction* is the vital one here. And nickel is about the only readily available metal that offers so much of it.

Do you have a metal problem? Corrosion? Wear? High Temperature? Then send for Inco's handy 16-page booklet: "Standard Alloys for Special Problems." It's your guide to more than 20 alloys developed specifically to give longer, better service under destructive conditions.

Remember, when you buy

INCO NICKEL *. . . you also get*

INCO + SERVICES

Whenever you are looking for answers to your metal problems, all the information and help we can give you are yours for the asking. For instance . . .

- + Corrosion Service
- + High Temperature Service
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INCO TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street New York 5, N. Y.

Nickel Alloys Perform Better, Longer

Volume 79 • Number 12

DECEMBER 1957

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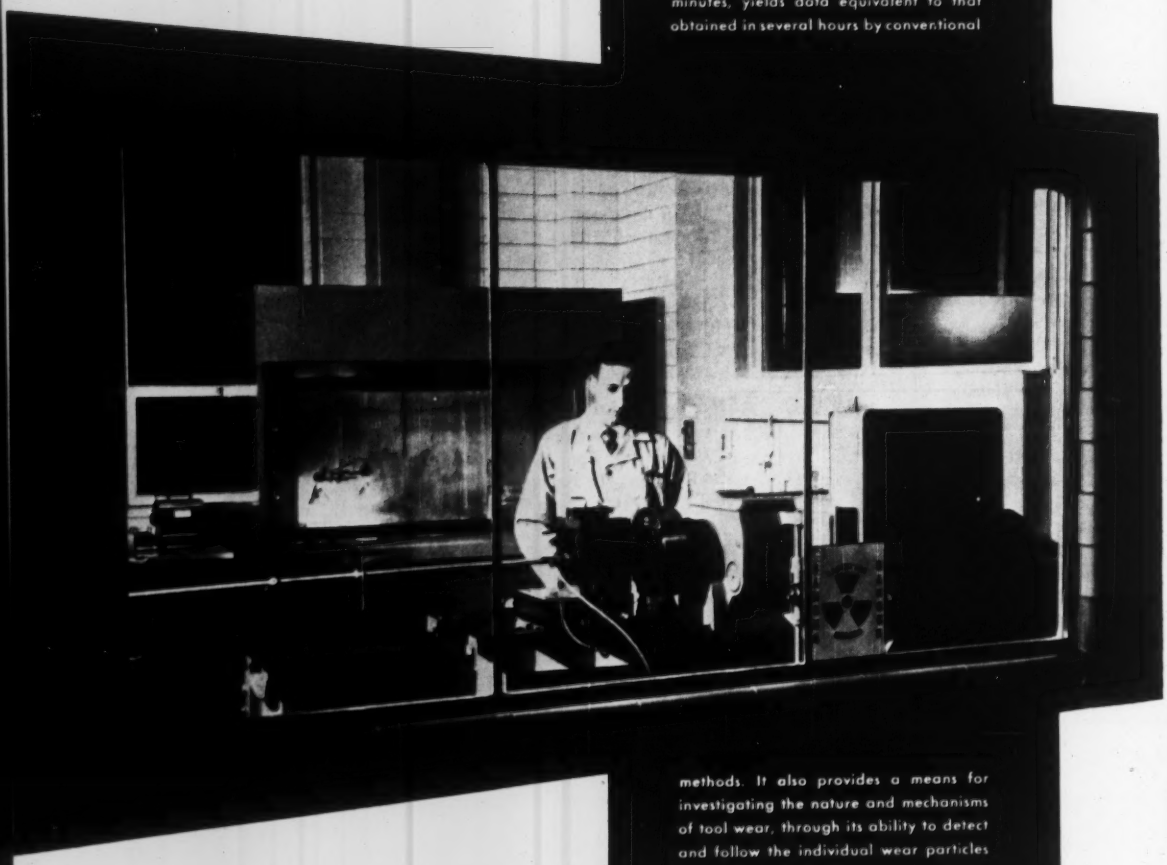
Radioisotopes Trace Tool Wear

Physical research on the tool wear problem is yielding many new and valuable findings and techniques. The Cincinnati Milling Machine Company's radioisotope laboratory for tool-wear measurements is a typical setup for the application of radioactive tracers to the measurement of tool wear and investigation of its mechanics. The Company's research program in metal cutting is described on page 1137.

A quantitative measure of the rate of tool wear is obtained by taking a cut of a few seconds duration with a radioactive tool, and measuring the radioactivity of the resulting chips to which the tool particles adhere.

The simple test, performed in a few minutes, yields data equivalent to that obtained in several hours by conventional methods. It also provides a means for investigating the nature and mechanisms of tool wear, through its ability to detect and follow the individual wear particles coming from the tool.



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MECHANICAL ENGINEERING

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Editor*

Joseph Leonard Kopf

A Tribute

In the loss by sudden death on October 21, of Joseph Leonard Kopf, there is consolation in the fact that he was stricken in the full lustihood of his physical and mental powers at the peak of his long career of faithful service to the engineering profession and to American industry. He was spared that deterioration of mind and body which sometimes is the tragic ending of an otherwise happy life.

At ASME he will be remembered as a man on whom the name "Joe" fitted appropriately and comfortably. His was a straightforward frankness tinged with kindliness and a sense of humor that revealed the warm affection he felt for his colleagues whether or not he shared their views. His direct manner of searching out essential facts and value judgments of complex and sometimes delicate questions, and of expressing both in language that was at once clarifying, succinct, and picturesquely simple, was softened by a roughish but friendly and disarming smile. One sensed in him a hard-headed shrewdness tempered by a warm-hearted affection for people and an understanding appreciation of their sensibilities and significance.

A man of sound industrial and financial judgment and engineering concept of economics, he served for more than 20 years as member, vice-chairman, and chairman of the ASME Finance Committee and as assistant treasurer (1944–1949) and treasurer (1949 until his death) of the Society. He became a national figure when he presented the Finance Report at the 1941 ASME Annual Meeting. Passing quickly over the statistics, he laid the report aside and launched into an inspiring exposition of what lay behind the "dancing figures" in terms of the human values represented by the Student and Junior Members, the Professional Divisions and Sections, the officers and the Council, and the Secretary and his staff. No one who was witness to this event is likely to forget it. The quickening into life of inanimate statistics—the transmutation of dollars into purposes, programs, and people—laid bare the inner resources of this man who, in a similar manner and on other occasions, inspired engineers with the significance of their responsibilities.

Early in 1957, at a dinner of the Board of Directors of Jabez Burns and Sons, Inc., of which he was president, he was honored in commemoration of the 50th anniversary of his employment with that company.

Under his guidance, many outstanding contributions to the technical development of industrial machinery for roasting and other processing of coffee, peanuts, and cocoa beans were made. These include the development of the Thermalo roasting principle, which is now in standard use in the coffee trade, development of continuous roasting, and changes in equipment which make possible the smokeless operation of coffee roasters. He held several patents for coffee-brewing equipment and processes.

From 1950 to 1952, Mr. Kopf was resident of the National Metal Trades Association. He was an active member of the Brewing Committee of the National Coffee Association from its inception and was instrumental in setting coffee-grind standards. He also contributed to the establishment of the Coffee Brewing Institute in 1952.

We like to think that millions of men, women, and children who never heard his name pledge him an unconscious tribute when they drink their coffee and cocoa and munch their peanuts.

On the day of the official recognition by the Society, at a meeting in Skytop, Pa. (in the form of a certificate of the Fellow Grade of membership in ASME), of his achievements as an engineer and executive and of the unselfish dedication of himself to the service of his fellow engineers, to the industry in which he was a leader, to his church and community, he was stricken in the presence of his friends and his peers. Surely, for him "the end crowns all." — G. A. S.

The pattern of development of high-strength alloys followed in the current titanium-sheet-rolling program

The

By N. E. Promisel[1] and William J. Harris, Jr.[2]

To review very briefly the situation that led to the development of the titanium-sheet-rolling program, and the underlying concept that has carried it to the present status, the following points were considered: (*a*) High-strength titanium-sheet alloys are currently of interest exclusively to defense industry. Consequently, there is no civilian market to justify industrial expenditures. (*b*) The technical requirement for improved quality is urgent, and historically cannot be accomplished by the traditional competitive development pattern within the short time before acute military need. (*c*) A program of such substantial expenditures is involved as to raise the question of the capacity of the industry to sustain it without special assistance, particularly in view of the preceding two items. (*d*) There is reasonable probability, after careful evaluation, that success is likely.

The over-all program has been divided into three phases to accomplish the following three major objectives: (*a*) To develop optimum techniques for production of new titanium-sheet alloys possessing adequate uniformity, reliability, strength, fabricability, and elevated-temperature characteristics, and the following room-temperature strength levels: 130,000-psi maximum annealed yield strength and 160,000-psi minimum heat-treated yield strength. (*b*) To develop design-engineering data required for use of these new titanium alloys in military equipment. (*c*) To enable manufacturers of military equipment to evaluate the reliability, fabricability, and serviceability of these improved titanium alloys in production quantities of sheet, and to establish the necessary manufacturing data.

Implementation of the Program

To implement the foregoing, the following steps were taken:

(*a*) Target properties were established by discussing with the Aircraft Research and Testing Committee of the Aircraft Industries Association the needs of the airframe, engine, and missile designers, and examining, with the aid of an Alloy Selection Group, numerous requirements submitted by individual companies. It was recognized that not all these properties would be achieved to the desired degree, and that while these targets represented the best practical compromise intended for maximum benefit to the greatest number of segments of industry, certain specialized and worthwhile requirements existed beyond these targets, which would have to be dealt with in separate, auxiliary programs. Weldable alloys for use in engines up to 1200 F are an example of such a special case. It will be noted that these targets (Table 1) represent a substantial increase in performance over existing alloys.

(*b*) An Alloy Selection Group was formed to examine the requirements of the consumer industry, and to select from candidate alloys submitted by the producers those most likely to meet the above targets. The target properties had been furnished to the producers, together with primary conditions that their candidates must already have been produced at least once in ingot size, must be accompanied by supporting data, and must be available to all interested producers. The final selection of alloys, and the abbreviated properties expected to be obtained from them, are listed in Table 1, together with the established target properties.

It will be noted that these are all alpha-beta alloys, using aluminum as an alpha stabilizer with good high-temperature-strength contribution, and molybdenum or vanadium as the beta stabilizer also contributing to high-temperature strength and ductility. All these elements increase the tolerance for hydrogen. The compositions tend to be balanced with respect to thermal stability, and in general represent the maximum proportions of strengthening elements without introducing excessive susceptibility to embrittling.

(*c*) Having established the targets and alloys, the Navy Bureau of Aeronautics, which is monitoring and co-ordinating the over-all program, contracted with the interested producers to conduct Phase 1 of the program as described above. Contracts became effective April 1, 1956, and are summarized in Table 2. These contracts are scheduled for completion at various times in 1958 but, as will be noted from Table 2, sheet material for preliminary use in connection with Phases 2 and 3 of the program is already beginning to be available. Inherent in every contract is the strictest quality control and record keeping so that the material produced will truly be thoroughly "pedigreed," that is, will have known histories beginning with the type of sponge used for original melting, and including every subsequent operation, thorough sampling and testing, either by the producer or, in some final cases, by other laboratories.

[1] Head, Materials Branch, and Chief Metallurgist, Bureau of Aeronautics, Department of the Navy, Washington, D. C.

[2] Assistant to the Director, Battelle Memorial Institute, Columbus, Ohio.

Based on a paper contributed by the Aviation Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–14, 1957, of The American Society of Mechanical Engineers.

Titanium-Sheet-Rolling Program

(*d*) To insure a continuing meeting-of-the-minds of all concerned, as well as frank and prompt disclosure of developed information, the Bureau of Aeronautics requested the Materials Advisory Board of the National Academy of Sciences to form a panel to serve in an advisory capacity to the bureau. The panel consists of representatives from the aircraft industry with various university and research-laboratory specialists, liaison representation from the producers and government, an additional rotating member from the aircraft industry, and, when desirable, invited specialists.

Progress Made

The status of this program will be reviewed in a later paper. Very definite progress has been made with respect to Phase 1, that dealing with optimum techniques for production of the alloys. The producers have given assurance that the opportunity to work out manufacturing methods on a carefully calculated basis has been of very great value, and they are saving time and providing a better product. They have co-operated very effectively and have furnished definitive reports on the work done and the problems encountered. Reproducibility has been a problem of major consideration, and variation limits were established, as shown in Table 3, that would be acceptable as demonstrating that the producers had these alloys under control. A sampling method, and target scatter bands listed in Table 3 will be applied to the problem of assessing uniformity. As of June, 1957, the alloys had not reached the state of full commercial availability, except for the 6Al-4V alloy in some thicknesses, but Phase 1 of the titanium-sheet-rolling program has not yet been completed. Progress is being made and the alloys probably will come very close to the target properties, and reliable processes will have been established through an orderly development plan.

Phase 2 deals with the collection of design data. The Navy Bureau of Aeronautics has initiated basic work, and the Wright Air Development Center of the Air Force is currently negotiating for the collection of the bulk of the design data. This program is utilizing the results of the activities of the Subpanel on Design Data, representatives of ANC-5, and other groups who have agreed on standardized testing procedures and on the priority of collection of data.

Phase 3 deals with the evaluation of the material in the plants of the airframe industry and the fabrication of parts, and service testing. Active studies are now in progress to integrate a number of individual contract efforts with a view toward minimizing the tremendous effort necessary in testing and in studying heat-treatment, welding, machining, and the like. Obviously, every contractor must have some information in all of these areas, but it would not appear that every contractor needs to have the opportunity for a detailed program in each of these areas.

From the foregoing discussion it can be seen that all

Table 1 Titanium Sheet Rolling Program

	Properties in solution-treated condition, Room temperature				Short-time properties in heat-treated condition, Room temperature			Short-time properties in heat-treated condition, 800 F		
	Ultimate tensile strength, psi	Yield strength, psi	Elongation, per cent in 2 in.	Bend ductility[a]	Ultimate tensile strength, psi	Yield strength, psi	Elongation, per cent in 2 in.	Ultimate tensile strength, psi	Yield strength, psi	Elongation, per cent in 2 in.
Target properties[b]	120,000	...	15	2T	180,000	160,000	10	130,000	105,000	15
Selected alloys										
3Al-6Mo[c]	135,000	...	15	2.5T	180,000	160,000	7	130,000	105,000	15
$4^1/_2$Al-3Mo-1V[c]	150,000	125,000	15	3T	170,000	150,000	10	100,000	80,000	15
6Al-4V[c]	130,000	120,000	10	6T	170,000	155,000	7	100,000	80,000	..
$2^1/_2$Al-16V[c]	100,000	...	15	2T	180,000	160,000	6	130,000	105,000	10

[a] Minimum 105-deg bend without cracking with radius of bend expressed as multiples of the thickness of the sheet.
[b] These properties were specified on the basis of information furnished by the airframe industry.
[c] Hydrogen shall not exceed 150 ppm.

of the criteria have been met and satisfied. The underlying philosophy of the program has been that a planned, co-ordinated, well-monitored effort with all facets of interests represented would make more rapid progress, in view of the extensive government funding required and within the budget available, than a piecemeal attack on the various specific problems, with probable delays in the commercial introduction of high-strength titanium-sheet alloys. This by no means suggests that such a program can or should be generally adopted.

Application to the Current Steel Situation

At the present time, the airframe industry is expressing much interest in the use of high-strength-steel sheet materials. The current status of their properties is reviewed briefly in a subsequent paper. It is clear that there are a number of stainless and alloy steels that are attractive and have the potential of satisfying airframe technical requirements. Some of these products are in limited production today; other steels, while developed for other airframe applications, have not been fully evaluated as sheet products or as airframe parts. If we consider the same three phases applicable to steel development as to titanium, we could ask ourselves the extent to which the philosophy of the titanium program is appropriate to the steel situation.

Phase 1 is the development of manufacturing techniques for the production of suitable metals. While some of the steel products have been produced as flat-rolled products, there is now a stated demand for high-strength-steel sheet materials that are rolled to much closer gage control than has been the case in the past. Commercial gage tolerances vary with the width and product involved, but in general are ±10 per cent. Through a series of questionnaires, the Materials Advisory Board has established that the bulk of airplane manufacturers at present would be reasonably satisfied with a gage tolerance one half of standard, while one quarter of standard may be a requirement in the future.

The development of manufacturing methods, and possibly new equipment, to meet this much tighter gage control represents an area where serious consideration might need to be given to an integrated program for the following reasons: (*a*) There is no apparent commercial outlet requiring these materials or justifying the substantial expenditures required for successful development. (*b*) There is stated to be an urgent technical need for material of improved gage control in view of critical weight requirements in exceedingly high-performance aircraft and missiles. (*c*) There is reasonable promise of success.

There is good reason to believe that an integrated program, with knowledge gained in one area or one facility made available to others, would result in successful completion of the program with minimum expenditure in minimum time. Before entering such a program, it would be necessary to establish beyond question of a doubt the factors that are listed previously and to insure that there would be co-operation on the part of all contractors concerned. In addition, it would be necessary to make certain that current developments within the steel industry were not already meeting or adequately approaching the requirement; and finally, it would be desirable to make some estimate of the likelihood of success in meeting worth-while targets. In the steel situation, then, there is some possibility that this, the largest of primary-metal industries by far, may require government assistance when faced by a high-cost defense-industry need of great urgency.

Application to Beryllium

Turning to a somewhat more speculative area, the sheet-rolling-program philosophy may be applicable to beryllium.

The attractive modulus and tensile strength of this very low density material have been the basis for renewed interest in aircraft applications. The problem is much more involved than for titanium, even considering titanium as it was eight or nine years ago. In considering the application of beryllium, we must start with a review of the availability of the ore. There are substantial quantities of beryl available but in deposits that are very difficult to exploit with current practices. Accordingly, in anticipation of a beryllium requirement for airframes, it will be necessary to develop an appropriate program of exploration for new deposits and mining of existing and new ores. It will be necessary to develop a process for beneficiation and extraction of the metal, perhaps involving concentrates that heretofore have not appeared attractive. Fundamental studies will be necessary to clarify the cause of current brittle behavior, and hopefully to indicate a remedy. It will be necessary to explore the melting and powder-metallurgy processes, and to consider the types and forms of alloy suitable for mill-product production. The properties and characteristics of these mill products would need careful evaluation for their suitability in aircraft applications. Both the Air Force and Navy Bureau of Aeronautics are undertaking programs to improve the properties of beryllium alloys, and are working out practices for production of mill products. However, in view of the sole defense need, the potential of an urgent technical requirement, the very large investment in facilities and knowledge required, and the uncertainty of success of the program, it appears timely to review pertinent aspects of geological exploration and technical evaluation in order to develop the outline of a material program that could support an aircraft program. Such an evaluation is now in progress under a panel of the Materials Advisory Board. In the case of beryllium, then, it may be that the philosophy of the titanium-sheet-rolling program, that is, the desirability of a co-ordinated and integrated attractive effort involving producers, consumers, and Government, may likewise be the logical road open to us.

Possible Further Application

The Aircraft Industries Association has recently indicated that many new metals may be of definite interest for aircraft application. They have suggested that encouragement be given to the development of beryllium, chromium, vanadium, molybdenum, niobium, rhenium, silicon, tungsten, and tantalum, and the two air services have, in fact, programs initiated in these fields. It is our sincere hope that new ways can be found for providing a suitable incentive in defense industry that will permit it to operate under the same competitive situation that has brought such substantial advances in technology to so many other fields in this country.

In summary, the titanium-sheet-rolling program represents one possible solution to the problem of making improved alloys available to a major industry.

Table 2 Summary of Bureau of Aeronautics Contracts With Producers for Alloy Sheet

Producer	Alloy: Composition	Contracted amount of sheet, lb	Quantity melted and form as of 3/1/57, lb	Sheet stock to be delivered: For preliminary evaluation: Gage, in.	Size, in.	Condition	Estimated[b] earliest date available and quantity, lb
Mallory-Sharon	Ti-6Al-4V	20,000	51,000 ingots of which 39,000 sheet-bar and sheet	0.020	36 × 96	Solution-treated and aged	July 1957-6000
				0.040	36 × 96		
				0.063	36 × 96		
				0.080	36 × 96		
				0.090	36 × 96		
				0.125	36 × 96		
	Ti-16V-2.5Al	20,000	50,000 ingots of which 36,000 sheet-bar and sheet				July 1957-6000
Rem-Cru	Ti-6Mo-3Al or Ti-4.5Al-3Mo-1V or Ti-16V-2.5 Al	20,000 of one alloy[c]	6000 ingots to slabs and hot bars	0.020	36 × 96	Solution-treated and aged	July 1957-3500
				0.040	36 × 96		
			6000 ingots to slabs and hot bars	0.063	36 × 96		July 1957-3500
				0.090	36 × 96		
			6000 ingots	0.125	36 × 96		
TMCA	Ti-4Al-3Mo-1V	20,000	8087 sheet-bar and sheet	0.020	36 × 96	Annealed product of two ingots	July 1957-4800
				0.040	36 × 96		
				0.063	36 × 96		
				0.090	36 × 96		
				0.125	36 × 96		
	Ti-6Al-4V	11,500	25,000 ingots of which 13,000 sheet-bar and sheet	0.025	36 × 120		
				0.090	36 × 120		
				0.078	36 × 120		
				0.050	36 × 120		
				0.050	36 × 96[a]		
				0.063	36 × 120	Annealed except as noted	July 1957-3600
				0.063	36 × 96[a]		
				0.050	36 × 120		
				0.063	36 × 120		
				0.032	36 × 120		
				0.032	36 × 96[a]		
				0.025	36 × 120		
				0.020	36 × 120		
				0.020	36 × 96[a]		

Target Standard gages and per cent to be furnished (Except for TMCA 6Al-4V)
0.020 in.-10 per cent
0.040 in.-20 per cent
0.063 in.-30 per cent
0.090 in.-30 per cent
0.125 in.-10 per cent

[a] To be furnished in heat-treated condition if equipment and techniques now being developed are perfected in time to permit performance within the time limit of contract.
[b] Predicated on the quality being satisfactory.
[c] Rem-Cru, after obtaining preliminary experience with these alloys, will select one of them for complete production investigation.

Table 3 Properties to Be Determined to Establish Achievement of Targets and Reproducibility

For targets

Room temperature
- Ultimate tensile strength
- 0.2 per cent offset yield strength
- Elongation in 2 in.
- Bend test (solution-treated and annealed)

Elevated temperature 800 F
- Ultimate tensile strength
- 0.2% offset yield strength
- Elongation in 2 in.
- Creep stability

For reproducibility

Room temperature
- Ultimate tensile strength
- 0.2 per cent offset yield strength
- Elongation in 2 in.
- Bend test (solution-treated and annealed)

Target criteria for measuring reproducibility

Property	2 Sigma variation: Within a sheet: Desired by aircraft industry, per cent	Data on Ti alloys, per cent	Agreed as target, per cent	Sheet to sheet: Desired by aircraft industry, per cent	Data on Ti, per cent	Agreed as target, per cent
Ultimate tensile strength	±3	±2 to ±3	±3	±5	±6 to ±7.5	±6
0.2 Yield strength	±3.5	±3.5 to ±4.5	±4	±6	±9	±8
Elongation in 2 in.	±2 absolute	±2 to ±3 absolute	±2 absolute	±4.5 absolute	±4.5 absolute	±4.5 absolute
Bond radius	...	...	undecided	...	...	undecided

MATERIALS *in Motion*

The materials-handling engineer has available new analytical methods which have emerged. While it might be thought that the techniques associated with operations research are too sophisticated and cumbersome for small problems, some of the new methods are useful for the solution of shop problems, including materials handling. Methods which have become valuable for materials-handling analysis are:

1 Work sampling.
2 Waiting line, or queuing theory.
3 Linear programming.

These newer analytical methods do not displace the older methods which have been used for years. Travel charting, flow diagrams, and other graphical methods are still valid; in fact, mention of these older analytical methods cannot be made without urging that more use be made of them. Too often, materials-handling flow problems which are apparently simple are not reduced to a chart or diagram model, and the range of potential solutions is thereby reduced. The simplicity of the older methods and the yields which they afford to the analyst are such that their usefulness will continue undiminished. The newer analytical methods are additional tools to be added to the kit of the materials-handling analyst and are not all-embracing wonder techniques.

Operations Research

The influence of operations-research methodology on materials-handling analysis has underlined the fact that materials handling is but one part of the manufacturing system: The real objective of materials-handling design is to contribute to the maximum efficiency of the system, rather than maximize effectiveness.

For example, in a plant which manufactures a well-known household item, the product line included several high-volume models which were as stable in design as men's white shirts are in the textile trade. The industrial-engineering department three years ago made an analysis of the plant layout and plant materials handling, and the result was a complete new layout with mechanized materials handling. But during the past three years the market has changed, so that now production schedules call principally for short runs of a large number of models each requiring a different layout. The mechanized conveyers are not flexible and are actually a hindrance to present production requirements, and are active only for the reduced requirements for certain older models. It was a case of one group, the materials-handling group, maximizing its function without relating its activities to the whole system.

Work Sampling

Work sampling, or ratio-delay study, is a statistical sampling technique used for analyzing jobs which do not have regular elements recurring at short intervals, such as a fork-lift truck operator in a warehouse. It eliminates the necessity for all-day continuous studies for one or several days.

The technique was developed by L. H. C. Tippett for use in the British textile industry, where it was found that the results were practically as accurate as continuous studies and required a lot less labor. Work sampling consists of making a large number of instantaneous or flash observations of a job or an operator at random times during the scheduled work period.

The theory of work sampling is that the ratio of each type of activity or state observed to the total number of observations is a measure of the proportion of time which is spent on each type of activity. For the theory to be valid, there must be a large number of observations distributed randomly over a relatively long period of time.

For example, suppose that 25 random observations

[1] Head of the Department of Industrial Engineering.

Contributed by the Materials Handling Division and presented at the Fall Meeting, Hartford, Conn., Sept. 23–25, 1957, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 57—F-26.

were made each day for 12 working days on a fork truck, with the results given in Table 1.

Table 1 Observations on Fork-Truck Operations

Condition observed	Number of observations	Per cent of total
1 Operating with load	201	67.0
2 Operating empty	40	13.3
3 Operating talking with foreman	11	3.7
4 Waiting for load	21	7.0
5 Operator idle	8	2.7
6 Operator away from machine	14	4.7
7 Down for maintenance	5	1.6
	300	100.0

According to the theory of work sampling, in this operation the truck is productive only 67 per cent of the time, while it is otherwise occupied for 33 per cent of the time for reasons for which supervision will have to decide the validity.

Utilization of Equipment

Work sampling is especially useful in analyzing utilization of equipment such as hand trucks, cranes, fork trucks, and other individual pieces as well as evaluating the performance of operators of materials-handling equipment. It is useful whether or not the materials-handling tasks are standardized and it is a relatively inexpensive method to apply.

One interesting result usually obtained in a work sampling study is a measure of the amount of materials handling being performed by individuals whose job is not materials handling nor whose wages, even in part, are reported as materials-handling expense. Conventional techniques do not yield valid quantitative results for the materials-handling effort of such job categories as operators, set-up men, and foremen.

One survey[2] found that direct labor operators were performing materials handling (not including manual transports within the operation area in loading and unloading work) approximately 11 per cent of the time and, in addition, were idle while waiting for materials-handling equipment 3 per cent of the time. Thus, about 14 per cent of the operator's time was nonproductive because of materials handling!

This same survey also came up with data which indicated that set-up men were engaged in materials handling 13 per cent of the time and were idle because of materials-handling delays an additional 5 per cent of the time. Also, foremen were engaged in materials handling 7 per cent of the time. These facts point up defects in the materials-handling plan in this plant and indicate sources of possible savings that ordinarily would be overlooked.

If the observations are coded carefully and recorded on punched cards it is possible to make a complete analysis of the data (usually several hundreds of observations) with minimum effort.

[2] Reported by W. L. Westerman, Ordnance Management Engineering Training Program, Rock Island Arsenal.

For the Materials-Handling Engineer—
New Analytical Methods Applied to Shop Problems

By A. F. Gould,[1] Mem. ASME
Lehigh University, Bethlehem, Pa.

Waiting-Line Theory

Waiting-line theory is a tool with which to make a rational analysis of many problems. Waiting is the condition that exists when one element entering into an operation is ready but another element required in the operation is not ready. The elements concerned may be people, equipment, or materials. Examples of waiting are: parts in manufacturing waiting for a machine which is loaded with work, or an operator waiting for parts, or parts waiting for transportation because trucks are loaded.

Waiting becomes a problem when arrivals at a servicing point occur randomly and the line cannot be reduced without creating a new waiting problem for the servicing facilities. This duality requires the solution to be one in which there is a balance between the idle time of units waiting for a facility and idle time on the part of the facility waiting for units to come to it.

The random variables which characterize waiting-line problems suggest that probability theory can be used, and experience indicates that the Poisson distribution can be used very effectively for arrival distributions; that is, the frequency distribution of arrivals to the waiting line.

The holding time is the time that an element of traffic is holding the operation facility and thus denying it to any other element of traffic. Holding time is also called servicing time. Servicing-time distributions may be one of the probability distributions and, in many instances, is exponential. The distribution of holding times often is not susceptible to exact mathematical expression and it is necessary to apply simulation methods.

The Monte Carlo Method

In the simulation or Monte Carlo method, the distributions are determined empirically or theoretically, and random choices are made from these distributions and used to trace large numbers of elements through the system, observing and recording the movements and delays which result. The observations are then analyzed statistically to develop the relationships between

arrival rates and service rates and waiting time and length of lines.

Waiting-line theory enables the analyst to determine the expected length of waiting line, the probabilities of various lengths of the waiting line, and the expected time that a unit will spend in line under conditions where arrivals to the line occur randomly and the servicing of the line occurs at regular intervals or in some distribution.

Much of the flow of materials in industrial plants occurs with regularity which makes it desirable to have the servicing rate equal the arrival rate, with the result that there is literally no waiting-line problem. However, when arrival rates and holding times are variable, the materials-handling engineer who lacks waiting-line theory is tempted to work with average rates, as in regular flow, and trouble may result. One of the theorems of waiting-line theory is that the length of the waiting line approaches infinity as the arrival rate approaches the servicing rate.

MATERIALS *in Motion*

Applying the Theory

An example of the use of waiting-line theory for a materials-handling problem is a situation in which it was desired to calculate the length of roller conveyer required for a repair loop. An electronic product came down an assembly line at a regular rate to a final test set; accepted product continued straight on to the pack and ship room, and rejected units were set aside on a table.

A new plan called for rejected units to be shunted onto a repair loop for repair and then around the loop to rejoin the main conveyer line at a point above the final test set. The number of rejects was constant from day to day but they occurred randomly within the day, and the repair time per unit was an exponential distribution varying from the short time required to tighten loose connections or replace standard elements to long repair jobs requiring disassembly of the unit.

A nub of the problem was to have enough conveyer to hold the backlog of units awaiting repair so that there would be no backup to the main line, and, at the same time, keep the length of the repair loop at a minimum because of space limitations. Calculations were made for various lengths of conveyer and numbers of repair stations which indicated the probability that sets awaiting repair would back up into the main line (management accepted the probability of an occurrence once per six months).

One of the most important contributions of the analysis was the determination of the probability that one or more repair men would be waiting for rejected sets; the waiting-line analysis clearly demonstrated the probable idle time of repair men to reduce to insignificance the probability of interfering with the main conveyer line.

Trucks in the Street

Another example is in connection with the design of additional truck docks for the receiving department of a plant in a congested section of a large city. Several days each week the line of trucks waiting to unload at the docks extended out into the city street, causing traffic interference and consequent complaints from the police. Management decided that the cause of the complaints should be eliminated by building additional unloading docks; but it was desired to keep the new construction to a minimum for reasons of cost, and more especially because the new docks would reduce space for storage.

Data indicated that the trucks arrived randomly during the period of greatest traffic density, between 7:00 a.m. and 9:00 a.m., and the times for unloading were distributed randomly and exponentially. Yard space was sufficient to permit six trucks to wait for unloading and so the problem became one of calculating the probabilities of 7 or more trucks in line for one, two, three, and four additional docks. In this case, management decided that it could tolerate interference with street traffic about once a month (probability of approximately 0.05 that 7 or more trucks would be waiting to unload).

Linear Programming

Linear programming is a method for the allocation of limited resources in accordance with certain constraints for the purpose of maximizing (or minimizing) an objective such as profit (or cost). It has been widely discussed for its value in solving problems of large magnitude, such as military shipments, location of warehouses, and so on. Actually, linear programming is also a useful analytical method for the shop materials-handling engineer.

It is useful for planning the allocation of materials-handling equipment in a plant. The objective may be expressed in terms of distances traveled, in which case the purpose of the study is to minimize the objective function.

Also, the familiar transportation model of linear programming was, as the name suggests, originally developed to calculate minimum cost schedules for moving goods from warehouses to destinations. Many large plants have a similar problem on a smaller scale. Such activities as distributing parts and supplies from storage areas to assembly areas can be handled by linear programming. The number of applications of linear programming to shop materials-handling problems has been limited, but the opportunities are there and it is up to materials-handling engineers to experiment with this analytical method.

Conclusion

Materials-handling engineers are urged to study and adapt the new analytical methods. One deterrent, of course, is that mathematical methods are often relatively expensive in terms of man-hours and cannot be justified for shop problems of modest size. However, refinements and short-cut methods are usually developed which make the method economically feasible for shop problems. Above all, the analytical methods yield solutions which are exact within the limits of the assumptions and the accuracy of the data.

Shipboard GAS-TURBINE Engine Tests

By P. W. Pichel,[1] D. E. Blackwood,[2] and W. P. Henry, Jr.[3]

Operating conditions, maintenance requirements, test difficulties, and the results of calibration and inspection in a 1500-hr accelerated-service test

Two of six mine-sweeping generator sets incorporating the Solar Jupiter gas-turbine engine, and delivered to the U. S. Navy in 1953, were subjected to a 1500-hr accelerated-service test during 1955 and the first part of 1956, to obtain an early evaluation of this prime mover under actual service conditions.

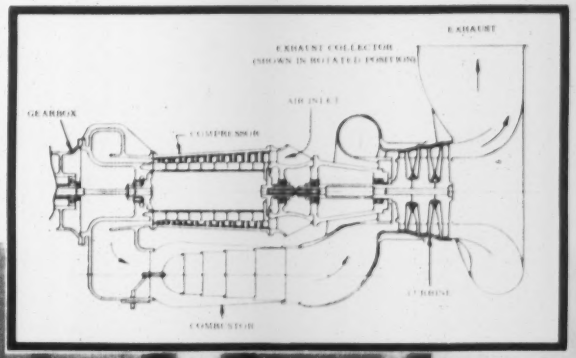
The Jupiter Model T-520J engine[4] used in the generator sets carries a nominal maximum rating of 500 hp, and was developed during 1951 and 1952 as the successor to the earlier Solar Model T-400J engine, the first gas turbine to be installed in a U. S. Navy ship.

The engine, shown in Figs. 1 and 2, incorporates a 10-stage axial-flow compressor coupled to a three-stage axial-flow turbine. A single can-type combustor is employed. Power is taken from the compressor end of the engine by means of a planetary-type reduction gear, which also incorporates accessory drives. It should be noted that this application requires full-load to no-load cycling, and the engine operates at a maximum power output of approximately 320 hp as required to drive a 200-kw d-c generator. This margin between required and available output was felt to be desirable from the standpoint of engine life.

[1] Project engineer, Solar Aircraft Company, San Diego, Calif.
[2] Project engineer, Gas Turbine Branch, Bureau of Ships, Washington, D. C. Assoc. Mem. ASME.
[3] Field service representative, Solar Aircraft Company, Washington, D. C.

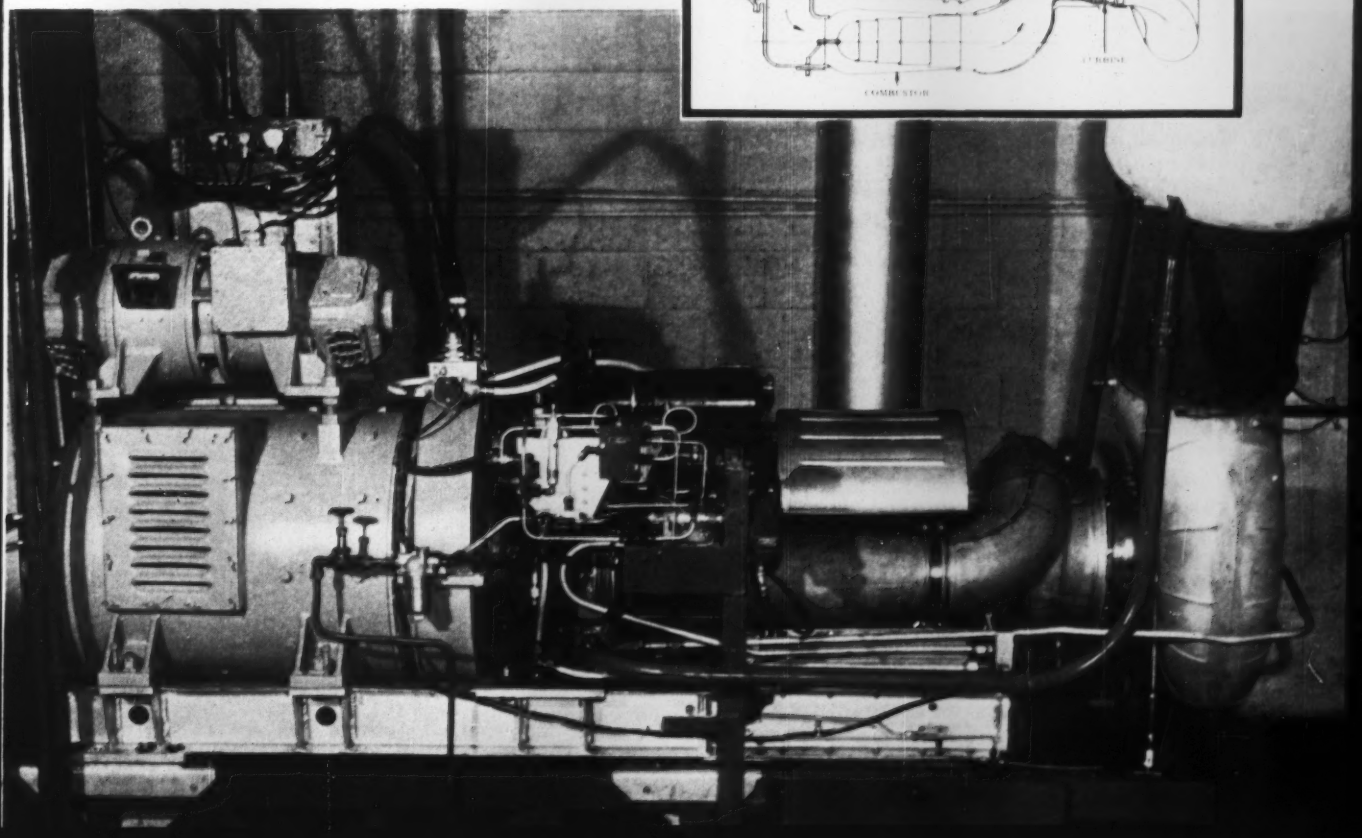
[4] "The Development of a 500-Hp Multipurpose Gas-Turbine Engine," by P. G. Carlson and I. M. Swatman, ASME Paper 55—S-36.

Contributed by the Gas Turbine Power Division and presented at the Fall Meeting, Hartford, Conn., Sept. 23-25, 1957, of The American Society of Mechanical Engineers. ASME Paper No. 57—F-21.



▶ **Fig. 1 Cross section of the Solar Jupiter Model T-520J gas-turbine engine**

▼ **Fig. 2 Factory test setup of the T-520J-1 mine-sweeping generator set**



Test Objectives and Operating Conditions

Objectives of the accelerated service test were: (*a*) Demonstration of reliability and low maintenance requirements; (*b*) establishment of future maintenance and overhaul schedules; (*c*) determination of the extent of maintenance support necessary for fleet operation; (*d*) obtaining improved durability and performance information; (*e*) determination of training required for operating personnel; (*f*) obtaining future gas-turbine engine-design information.

Performance of the engines up to 900 hr exceeded expectations, and the test was extended from 1000 to 1500 hr. Complete disassembly and inspection of one engine at 1000 hr showed all parts to be in good condition. The test was conducted in the vicinity of Charleston, S. C., under the following load conditions:

100 hr	No load
175 hr	Normal pulse-load schedule at sea
725 hr	Full load dockside, using a salt-water box for loading
25 hr	Normal load at sea
475 hr	Full load dockside
Total 1500 hr	

During the 1500 hr of operation, ambient temperatures ranged from 29 to 103 F, and the humidity was predominantly high. Conditions under which salt spray could be inducted in the engine air-inlet ducts were encountered during operation at sea, and a moderately high degree of contamination of inducted air was present during dockside operation as a result of exhaust gases from other boats and recirculation of exhaust gas from the gas-turbine engines.

Maintenance of the engines was scheduled at 100-hr intervals, with certain additional items to be performed at 500-hr intervals, as follows:

100-Hr Maintenance. (*a*) Replace main fuel-filter elements; (*b*) inspect and clean spark plug; (*c*) inspect starter brushes; (*d*) inspect combustor liner for cracks; (*e*) inspect first-stage turbine blading; (*f*) inspect turbine cooling-air shaft seal.

500-Hr Maintenance. (*a*) Perform items under 100-hr schedule; (*b*) remove air-inlet shroud, and examine blading of compressor-inlet guide vane and first-stage rotor for contamination; (*c*) check oil level in speed-sequencing switch; (*d*) inspect turbine-inlet thermocouples; (*e*) change engine lube oil; (*f*) replace element in secondary fuel filter; (*g*) replace lube-oil-filter elements; (*h*) clean fuel drain valve; (*i*) check operation of starter.

The engines were operated and maintained by relatively inexperienced Naval personnel with the assistance of the manufacturer's field-service representatives. All trained crew members had been transferred to other assignments prior to the test.

Performance of Engines During Test

With one exception, no difficulties requiring major disassembly of the engines were encountered during the entire test. At the end of the 1500-hr period, both engines were in good running condition. The 20 per cent down time for the engines during testing was divided approximately equally between scheduled maintenance and forced outages.

Treatment of the engines with Carboblast (trade name for lygno-cellulose pellets) was included as a regular maintenance item when it was discovered that excessive amounts of carbonaceous material were accumulating in the compressors. Approximately 2 qt of Carboblast were introduced into the compressor air-inlet opening with the engine idling.

Modifications were made during the test to correct difficulty with the fuel accumulator, which is used to provide a fuel "burst" to assist engine lightoff; the fuel-pressure-gage transmitter; and piping in the fuel system. The original type of fuel accumulator incorporated a rubber bladder which deteriorated in service. A spring-loaded piston type was substituted. Restrictors were installed in the pressure connection to the fuel-pressure-gage transmitter to prevent damage to the transmitter at engine shutdown, when the fuel pressure momentarily reaches a peak. Fuel-system aluminum tubing was found subject to cracking at the flares, and was replaced with stainless-steel tubing.

Failures of the turbine air seal, which permitted compressor discharge air to enter the third-stage end of the turbine rotor for cooling the second-stage rotor disk, were responsible for more down time than any other single component. Following the test, the seal was eliminated by a modification permitting compressor seventh-stage air to be bled into the compressor rotor drum and then directly into the hollow turbine shaft.

Later engine models utilize exhaust rather than inlet-temperature sensing because of limited life of the turbine-inlet-gas thermocouples and gas leakage around them. Other accessories which gave trouble, leading to a change in the type of component, include the speed-sequencing switch, the starter, the fuel control, and the acceleration limiter. Tables 1 and 2 indicate items replaced or repaired during the test.

Calibration and Inspection of Engines After Test

At the end of the 1500-hr test the engines were factory overhauled and compressor cleaning techniques evaluated. This program included the following steps: (*a*) Inspection of compressors to determine the degree and nature of contamination; (*b*) calibration of the engines to determine operating characteristics in the as-received condition; (*c*) cleaning of the compressors by the introduction of Carboblast and water; (*d*) recalibration after each cleaning operation; (*e*) complete disassembly for inspection prior to overhaul.

The results of the engine-calibration tests including the effects of Carboblast cleaning water washing, and sea water injection are shown in Fig. 3. The full-load fuel consumption of both engines in the as-received condition was between $6^1/_2$ and 7 per cent greater than the flow rate in the original acceptance tests. Before cleaning, both compressors showed heavy oil contamination, with the oily deposit becoming progressively more carbonaceous from the front to the rear stages. The single application of Carboblast to engine 1005 was effective in removing deposits from the compressor casing and the concave sides of the blading in the rear

Table 1 Items Replaced—Two Engines

Item	Number replaced
[a]Turbine air seal	12
Combustor liner	9
Fuel-pressure-gage transmitter	6
Spark plug	3
[a]Speed-sequencing switch	3
[a]Starter	3
[a]Lube pump	3
Acceleration limiter	2
Fuel nozzle	2
[a]Fuel accumulator	2
[a]Fuel-system piping	2 sets
[a]Oil-pressure switch	1
[a]Fuel-boost pump	1
[a]Control relay	1
Spark-plug lead wire	1

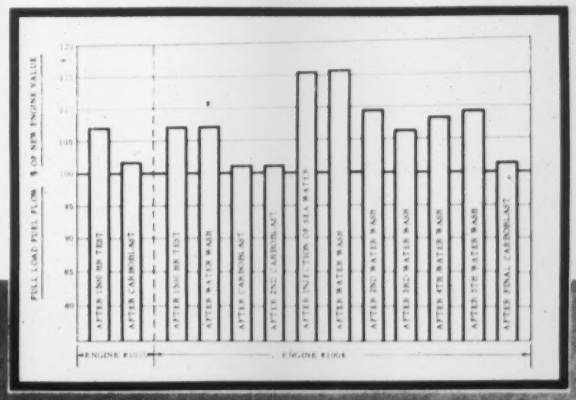
[a] Indicates items causing forced outages.

Table 2 Items Repaired or Adjusted—Two Engines

Item	Number of times repaired or adjusted
[a]Fuel control (governor)	5
[a]Acceleration limiter	3
Starter	2
[a]Lube pump	1
[a]Electrical connector	1
Turbine scroll	1

[a] Indicates items causing forced outages.

▶Fig. 3 Per cent of new-engine full-load fuel flow after compressor cleaning with Carboblast and water wash or injection of sea water



◀Fig. 4 Stages 1, 2, and 3 of the compressor stators, showing the loss of small pieces of material from the leading and trailing edges, attributed to intergranular corrosion

▼Fig. 5 Cracks in the inner and outer rings of the upstream side of the first-stage turbine nozzles of engine 1005

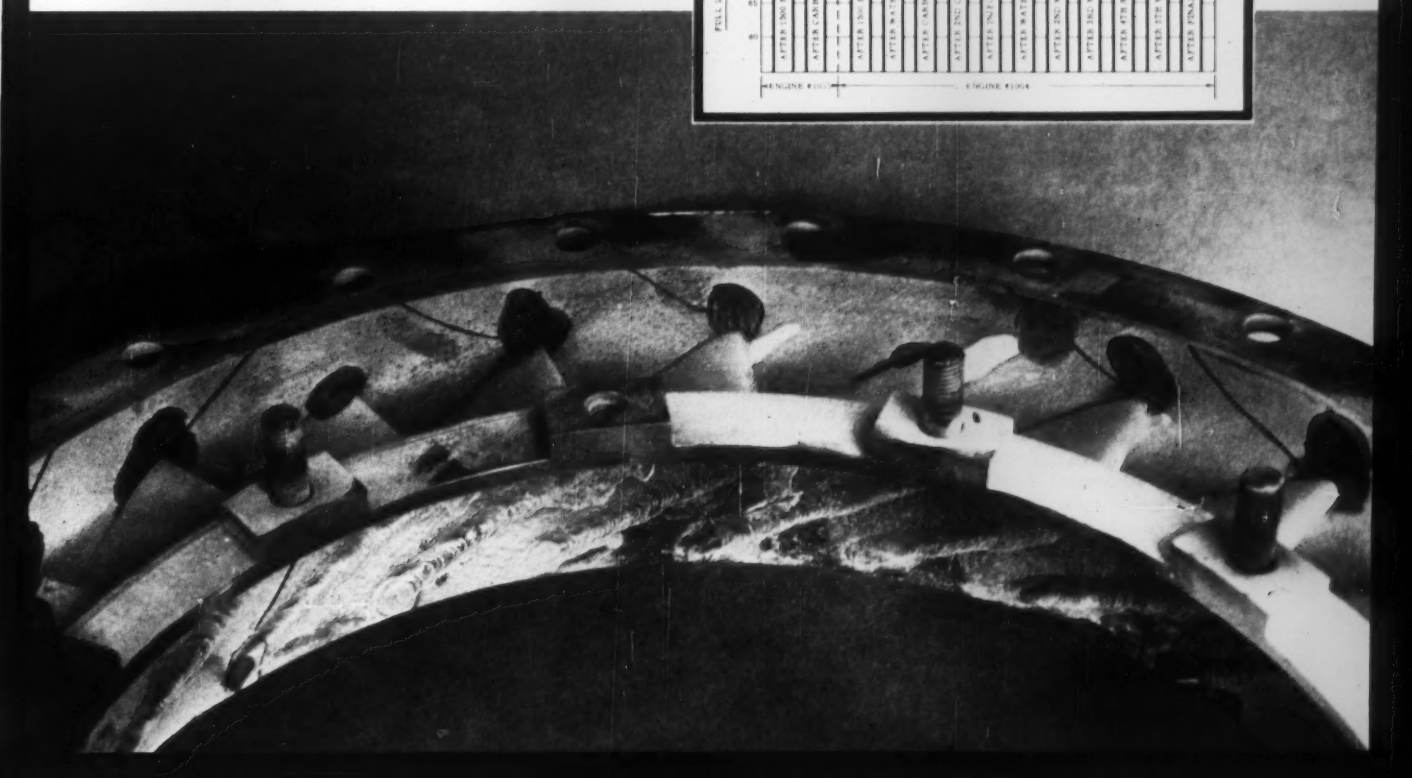


Fig. 6 Cracks are shown in the inner ring and the downstream vane of the first-stage turbine nozzle of engine 1004

stages. A thin oily deposit was still present on the blading in the front stages, and comparatively heavy deposits remained on the convex sides of the blades in the rear stages. The compressor of engine 1004, which was subjected to a total of three applications of Carboblast and five fresh-water washes, was much cleaner than the compressor of the other engine, although traces of salt deposit remained from the artificial contamination with sea water.

Complete inspection of both engines indicated that all major components were in excellent condition and suitable for further use, with the exception of:

1 The compressor-inlet guide vanes, which are sheet metal parts, were distorted, a condition believed to result from the application of Carboblast to the engines.

2 Small pieces of material had been lost from the leading and trailing edges of the compressor stator vanes in the first three stages. This condition was attributed to intergranular corrosion occurring as the result of sensitization of the Type 316 stainless material during the brazing operation used in fabrication of the stator assemblies (see Fig. 4).

3 Cracks were present in the inner and outer rings and in several vanes of the first-stage turbine nozzles. This condition is shown in Figs. 5 and 6.

Design changes made subsequent to delivery of the engines, either to improve producibility or performance, have eliminated these conditions. Compressor-inlet guide vanes are now made from rolled vane stock rather than sheet metal. Type 410 stainless-steel rolled stock is also used for the compressor stator vanes. In the older design of the first-stage turbine nozzle, the nozzle also served as a structural member providing partial support for the entire turbine casing. In later engines, the nozzle carries no structural loads and offers less restraint to thermal effects.

Conclusions

Performance of the engines was very gratifying when it is considered that they were the first of their type to be placed in service and that there were no failures of high-speed rotating parts. This success is directly attributable to the conservative design of the engines and to the moderate maximum-load demand in this particular application, although the cyclic nature of the load is not conducive to long life.

More emphasis is needed on the development of reliable accessory equipment of reasonable cost for small gas turbines, as indicated by the amount of difficulty that was experienced with components in this category.

Although progress has been made in this direction since the time of manufacture of the engines tested, continued effort is indicated.

Experience during the 1500-hr test, and the subsequent test-stand evaluation of cleaning techniques have shown that use of Carboblast cleaning material is a simple and effective means of restoring performance lost as a result of compressor-blade fouling. Water washing is not felt to be as satisfactory a procedure, inasmuch as it is only effective on salt or other water-soluble deposits, and distilled or reasonably soft water is required for best results.

Lower cost for overhaul of gas-turbine engines relative to comparable reciprocating internal-combustion engines represents an anticipated advantage of the former type of prime mover. Experience gained in overhaul of the two engines after the 1500-hr test indicates that an overhaul cost of 5 to 10 per cent of the original cost of the engine can be expected for current versions of the same basic engine. This figure may be compared to a cost for major overhaul of 30 to 40 per cent of the new-engine cost for reciprocating engines.

Two Airlines Report On Engine Overhaul[1]

MAINTENANCE OF AIRLINE ENGINES

Overhaul of the Aircraft Piston Engine Attains Production Line Speed; Then, the Turboprop Brings Changes

PISTON ENGINE OVERHAUL[2]

It is only in recent years that airline activity has grown to sufficient size to attract professional tool design attention. In the evolution from the job to production-type shop, development of specialized tools unique to engine overhaul was necessary both to increase the potential production and to accomplish the needed cost reduction.

It is logical that the subassembly of the engine having the highest production rate as a unit—the cylinder—received the most attention as concerns mechanization.

The cylinder-overhaul line contains many standard tools and production items; however, a few tools are unique.

Removal of Shrink-Fit Parts. One of the first operations in cylinder overhaul is the removal of shrink fit parts. The cylinder is heated in a gas-fired automatic oven. The oven delivers cylinders on a 5-min schedule ready for work. Cylinders are heated to 450 F at the time of ejection. Cylinder heating and expansion problems have been minimized by heating the cylinders from the inside with as much of the heat as possible directed to the cylinder head itself. The heat from the cylinder then heats the balance of the oven (Fig. 1).

The tool pictured in Fig. 2 is a water-cooled puller used to remove steel exhaust-port liners. The puller consists primarily of a water chamber and pulling head on which six jaws are mounted. These jaws are expanded by means of screw threads on the handle of the puller. When the puller is installed and the jaws are in place, water is injected into the water chamber which shrinks the liner. Operation of the slide hammer pulls the liner.

Boring and Reaming. The cylinder-guide-boss boring machine is the first machine that has been designed specifically to bore the valve guide hole which previously was reamed (Fig. 3). The boring-type operation has been most successful in restoring alignment (to manufacturing specification) of the boss bore with the seat bore regardless of disturbance due to burning, pounding, and so on. The semiautomatic nature of this tool allows the operator to prepare the next cylinder for rework. The machine turns out more work of higher quality with one less man than formerly at this job station.

Grinding Valve Seats. This is accomplished on a multiple-spindle seat grinder developed and built for this purpose alone.

The grinder, Fig. 4, is operated by one man (using all

[1] Condensed from two papers contributed by the Aviation Division and presented at the Semi-Annual Meeting, San Francisco, Cal., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Condensed from "Tools, Ideas, and People Perform Aircraft Engine Overhaul and Maintenance," by S. P. Youngblutt, General Foreman, Engine Overhaul Section, United Airlines Maintenance Base, San Francisco International Airport, San Francisco, Cal. ASME Paper No. 57—SA-38.

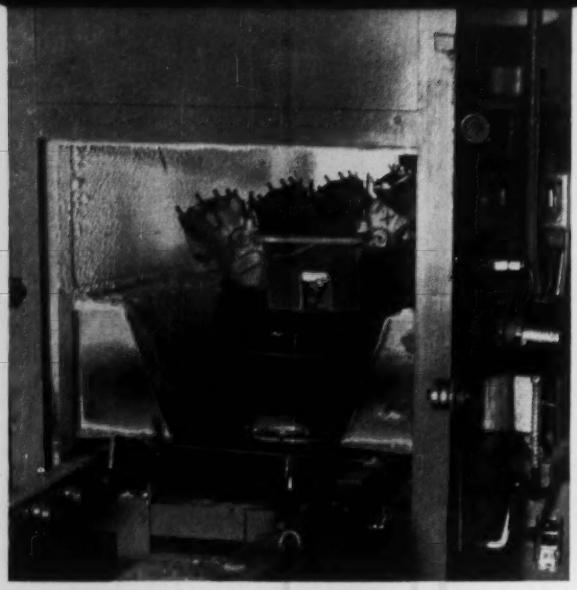


Fig. 1 The cylinder-heating oven, first special tool in the cylinder-overhaul sequence. Cylinders are heated to 450 F for removal of shrink-fit parts. The cylinder subassembly, with its high production rate, has largest number of special tools.

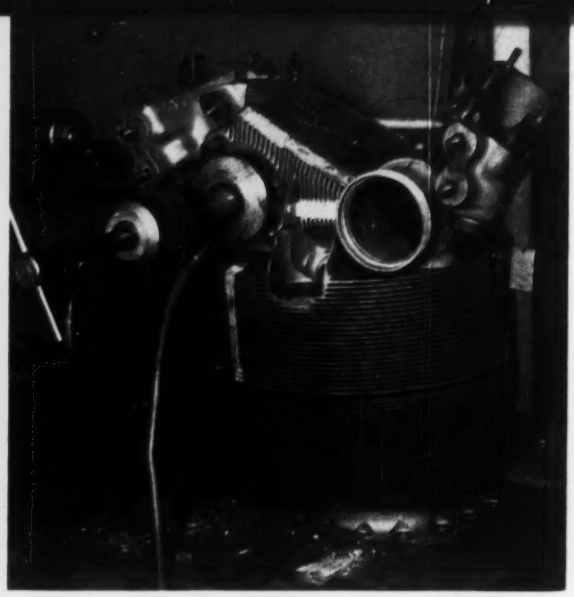


Fig. 2 Special puller to remove the exhaust-port liner. The tool, developed by an employee of the Overhaul Section, reduces the time of this operation from 15 min to 30 sec. The puller is water cooled for quick shrinking of the liner.

four spindles) and, because greater power and grinding pressures can be applied, seat-grinding time is reduced to 5 min per seat. The grinder features innovations such as:

1 Crushed dressing of grinding wheel.
2 Automatic installation of pilot.
3 Choice of concentric or eccentric method of grinding by head change only (rapid change).
4 Ability of one operator to operate four grinding heads.

Lapping Cylinder Flanges. The highly stressed, radial engine, cylinder flange must be returned to a clean and true condition at each overhaul. Fig. 5 is a front view of a semiautomatic lapping machine designed and assembled by a shop mechanic. The machine is, primarily, a cast-iron base and gear box from a wringer-type washing machine powered by a $^1/_3$-hp motor. An interchangeable lapping block is adapted to the agitator drive. The cylinder sits free on the lapping block and lapping reversal is obtained using cylinder inertia.

Measuring Leakage. When the cylinder is completely assembled, it is checked for valve leakage, using an instrument built into the cylinder roller conveyer line. All openings are plugged, the cylinder filled with pressure air, and the rate of leakage measured, Fig. 6.

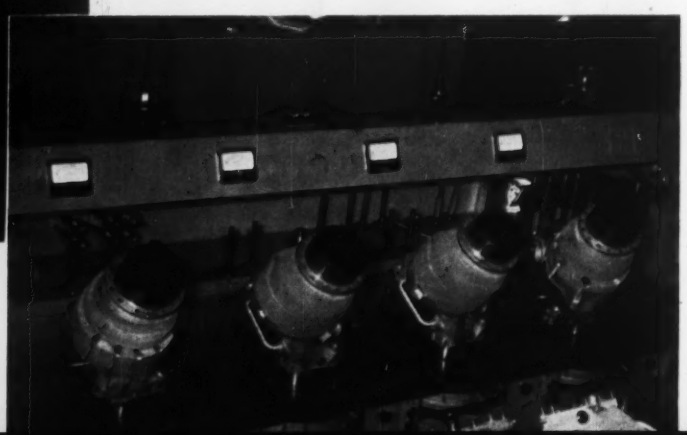
This instrument embodies a new idea in air measurement. A balanced diaphragm, employing a fixed flow rate on one side and a variable flow rate on the other side, positions the pointer to indicate the rate of leakage and is the first practical means of cylinder leakage testing on a production basis.

People Make the Difference

People and their acceptance of ideas and tools are the key to mechanization and production.

◀ Fig. 3 The valve-guide boring mill, first machine designed specifically to bore the guide hole which previously was reamed. The operation restores alignment, regardless of the effects of burning and pounding. A semiautomatic tool.

▼ Fig. 4 Grinding valve seats. When the desired cut is accomplished, the grinder stops cutting. Eccentric grinding is used until the indicator shows roundness has been accomplished; concentric grinding for final polish.



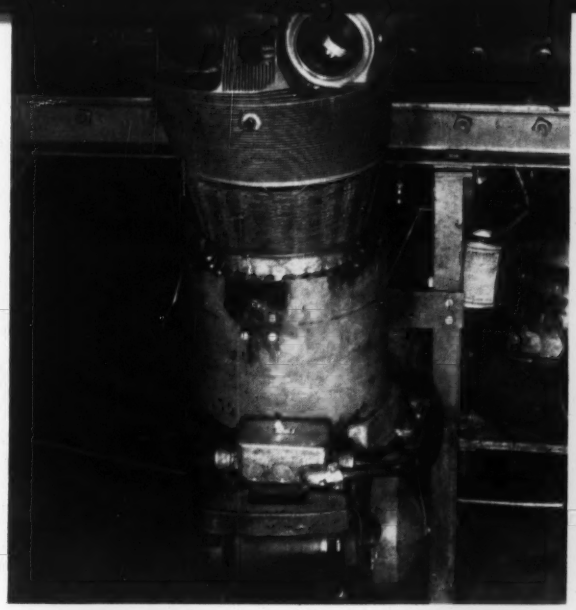


Fig. 5 The cylinder-flange lapping machine. This semiautomatic device, designed and assembled by a shop mechanic, uses the cast-iron base and gear box from a washing machine. A lapping block is adapted to the agitator drive.

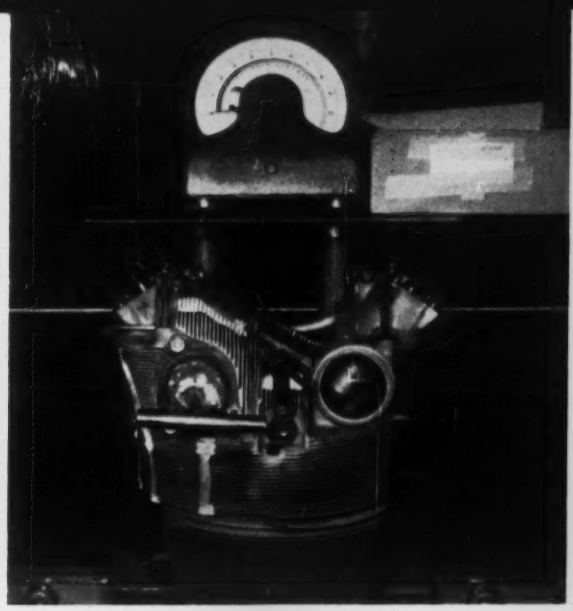
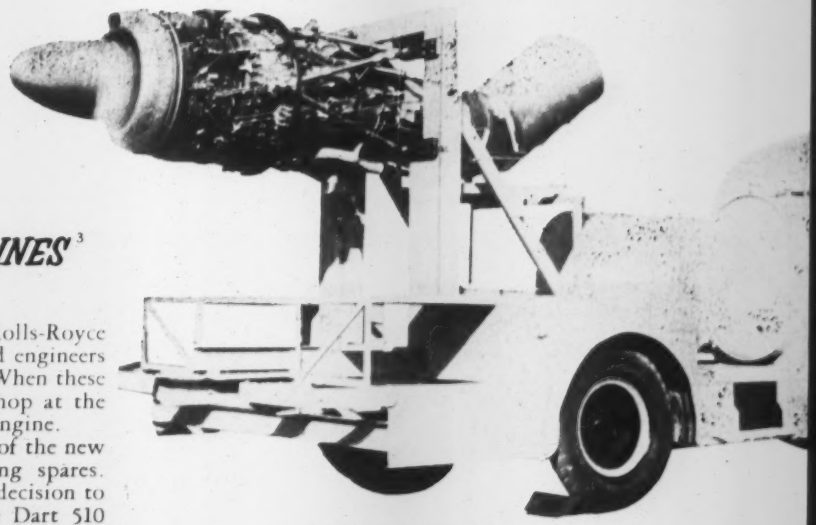


Fig. 6 Checking for valve leakage. This instrument uses a new principle in air measurement. The pointer is positioned by a balanced diaphragm with a fixed flow rate on one side and a variable flow on the other.

We have found that the real key to acceptance is improved communications and group and individual participation. There is evidence that people normally will set higher goals for themselves than those that will be set by management and, further, these goals will be met, whereas management goals are usually achieved only with difficulty. Further, participation by an individual or a group in the solution of a problem insures that the best thinking of all personnel concerned will be brought to bear on the problem.

CHANGE OVER TO TURBINES[3]



BEFORE Capital undertook the overhaul of Rolls-Royce Dart turboprop engines, shop supervisors and engineers were sent to England for months of study. When these men returned, they laid out our overhaul shop at the Washington Base to handle the new type of engine.

Equipment was planned on the basis of 75 of the new 4-engined aircraft and 370 engines including spares. The Dart's reliability has since led us to the decision to sell 14 of the spares. Experience with the Dart 510 indicates a failure rate of about 115,000 engine hours per failure.

New units and equipment purchased by Capital for Dart overhaul included:

1 New test cell equipment.
2 Balancing equipment.
3 Special stands and jigs.
4 Accessory shop test equipment.

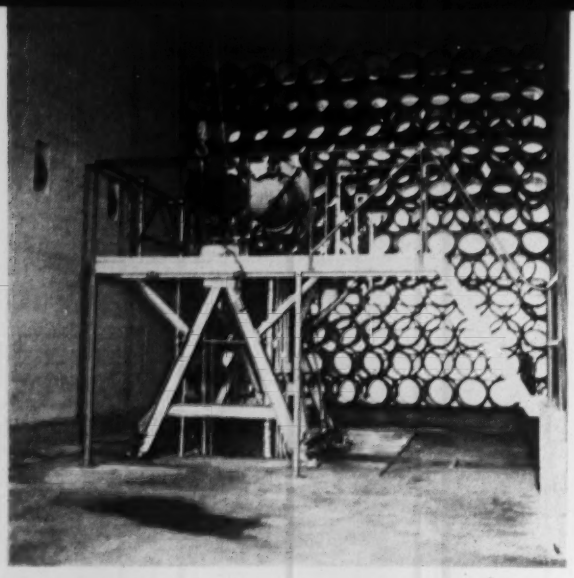
Capital Airlines Data on the Dart Turboprop Engine

1	Engine hours	300,220
2	Engine failures—1956	14
3	Engine hours per failure—1956[a]	21,444
4	Time between overhauls (CAA approved)	1500
5	Average bare engine overhaul cost (labor)	$1150.00
6	Average bare engine overhaul man hours	490.00
7	Average bare engine overhaul material cost	$3850.00
8	Overhaul cost per engine hour (present)	$3.51

[3] Condensed from "Capital's Approach to the Overhaul and Maintenance of the Viscount-Installed Rolls-Royce Engine," by J. B. Franklin, Vice-President, Operations and Maintenance, Capital Airlines, Washington National Airport, Washington, D. C.

[a] Includes experience with the Dart 506. Experience with the Dart 510 alone indicates a failure rate of 115,000 engine hr per failure.

Above figures represent 6 months' average. Average engine life experienced 1425 hr.



Curran test cell, showing oil drums installed in the air intake to eliminate engine surging with flight propeller. The Rolls-Royce turboprop engine is tested as a completely built-up power plant, just as installed in the aircraft.

Test cell instrument panel. The hangar-type cell permits the engine control settings to be carried out under actual conditions. This saves both test time and time expended on minor readjustments after installation in the aircraft.

For the volume of Dart engines that we were going to overhaul, economical handling required that we install this equipment at a cost of $500,000.

We found that our balancing equipment, installed for the Wright 3350, did a nice job on the Dart with the exception of compressors, which were too large. Our plating shop was able to handle all but the anodizing work. The test cell could handle an ordinary run-in, but calibration was more difficult, and we therefore installed a dynamometer (Dynetric) test cell. As an interim unit, we constructed two portable test cells, using old bus chassis as the base, and they are still in use as "Interconnection run-in" units.

Most tooling of general application to the piston engine is still required for the turbine. Obvious exceptions: Cylinder-honing and lapping machines; carburetor and injection-pump test rigs.

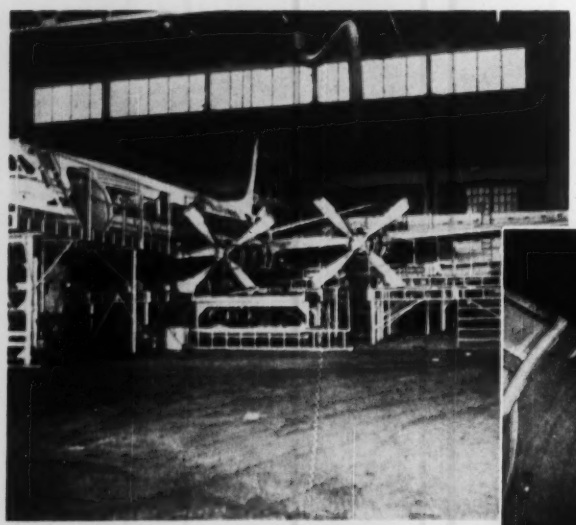
There has been no problem with respect to foreign standards. When dealing with a successful engine, the same high engineering standards apply wherever you are.

In the Capital shops we keep a complete range of taps and dies to the British standard thread specifications. British-size wrenches had to be provided, of course, but personnel have experienced no confusion or delay in selecting the right wrench.

Rejection Rate

The experience with newly overhauled Dart engines has shown that a low rate of failure and/or rejection can be expected. Five per cent for all rejects is a fair average.

A new sense of values is required in the actual testing. Ambient conditions of outside air temperature and pressure must be accurately measured and accurately applied to test settings and corrections. Changes in outside air temperature or atmospheric pressure have a pronounced effect on turbine-engine performance. If sufficient attention is given to these variations, it can have an appreciable bearing on the life of the "hot end," and on the scrap rate at scheduled overhaul.

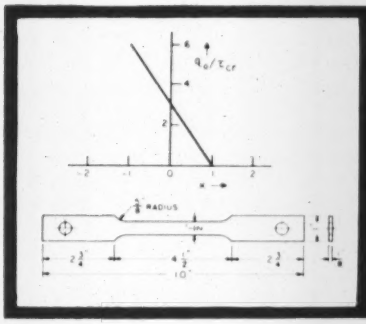


◀ The Viscount airplane overhaul dock in Hangar #2, at the Washington Base. From the beginning, Capital proposed to overhaul their Rolls-Royce Dart engines in the same manner they had employed with piston engines.

▼ Preparing to inspect the turbine on a Dart 510 engine. The Dart employs a two-stage centrifugal compressor, seven straight-flow combustion chambers (the fuel is low-volatile kerosene), and a two-stage axial-flow turbine.

Fig. 1 The graph shows the relationship $q_0/\tau_{cr} = 3.0\ (1 - K)$ Positive values of K represent tension, negative values compression. The load to initiate plastic flow decreases with positive K, increases with negative K.

By S. K. Setty,[1] J. T. Lapsley,[2] and E. G. Thomsen,[3] Mem. ASME



STRESSES *After* HARDNESS

Fig. 2 The flat test specimen of annealed mild steel (SAE 1020), carefully machined to retain flatness and minimize machining stresses. This is the specimen used to determine hardness under uniform tension, there being no stress gradients such as exist where tension is induced by bending.

Testing metal specimens for hardness while subjecting them to uniform and gradient stresses. Results bear out theory: Materials become softer under tension, harder under compression.

SINCE hardness measurements have come into widespread use for production control and for predicting mechanical properties of heat-treated steels, it is important to understand errors that may be introduced by residual stresses or by stresses due to external loading.

Fink and Van Horn (1)[4] appear to have been the first to point out that stresses may affect hardness readings. Kokubo (2) subjected small metal specimens to elastic bend tests, measuring Vickers hardness under stress. More recently, Blain (3) bent small disks of a hypereutectoid steel to a dish-shaped configuration, and found that true hardness varied from the tension to the compression side by a factor as high as five.

The present investigation set out to determine hardness under uniform stress as well as bending (gradient) stress, and during states of stress below and at the instantaneous yield condition of the metal.

Theory of Hardness Under Stress

Penetration hardness tests of the Brinell and Rockwell type give hardness numbers in terms of resistance to local plastic penetration, into the test piece, of a ball or cone at constant load. The hardness numbers, therefore, must be related to that state of stress induced in the test piece under the indentor which will be just sufficient to prevent continued penetration. Hence this region of metal must be at or near the instantaneous yield condition, and any simultaneously superimposed stresses could have the effect of either increasing or retarding yielding at this point. Determination of the state of stress under the indentor which will fulfill the yield condition should reveal whether or not superimposed stresses will influence the hardness readings.

Mathematical difficulties prevent the evaluation of the yield when the indentor finally has come to rest. It is assumed, therefore, that an analysis of initial yielding, when an indentor just contacts the surface, can be correlated with the final hardness number.

The yield condition can be determined under a ball indentor if Hertz's solution (4, 5) for the elastic state of stress, and Tresca's maximum shear yield criterion are invoked. Hertz's stress solution for a sphere penetrating a flat surface, assuming the contact area to be spherical, shows that the maximum shearing stress occurs at a point on a line coincident with the direction of the movement of the ball (axis of indentor) a small distance below the surface of the indentation. For the case of steel with Poisson's ratio approximately equal to 0.3 and the radius of the spherical indentor equal to a, the maximum shearing stress resides at a depth of approximately $a/2$ and has a magnitude of approximately $0.33q_0$. In this case, q_0 is the surface pressure at the point of contact between indentor and test piece and is proportional to the so-called true hardness.

[1] Lecturer in Mechanical Engineering, University College of Engineering, Bangalore 2, India.
[2] Associate Professor of Industrial Engineering, University of California, Berkeley, Calif.
[3] Professor of Metal Processing, University of California, Berkeley, Calif.
[4] Numbers in parentheses refer to the Bibliography at the end of the paper.
Contributed by the Research Committee on Metal Processing for presentation at the Annual Meeting, New York, N. Y., Dec. 1-6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 57—A-77.

Superimposed Stress

Since this shearing stress occurs on planes at 45 deg to the axis of the indentor, it could be increased or decreased by superposition of additional induced stresses depending on whether the shearing stresses associated with the induced stresses at this point are additive or subtractive. The condition for yielding then can be expressed at the point of maximum shear stress by the following equation

$$\tau_{cr} = \frac{\sigma_0}{2} = 0.33\, q_0 + \frac{K\sigma_0}{2} \quad \ldots\ldots\ldots [1]$$

where τ_{cr} is the critical shearing stress, which is constant in Tresca's criterion for the initiation of plastic flow and is equal to one half the yield stress σ_0 in simple tension; $\frac{K\sigma_0}{2}$ is the shearing stress due to the superimposed residual or load stress parallel to the surface of the test piece already present in the material. The factor K is a factor of proportionality which indicates the magnitude of the superimposed stress and can assume values of $-1 \leq K \leq +1$, i.e., ranging from the yield strength in compression to that in tension, respectively. Rearranging Equation [1] in dimensionless form

$$\frac{q_0}{\tau_{cr}} = \frac{1 - K}{0.33} = 3.0\,(1 - K) \quad \ldots\ldots\ldots [2]$$

Equation [2] is shown graphically in Fig. 1, and the following observations can be made. If the residual stresses are zero ($K = 0$), consequently the indentor load required to initiate plastic flow is equal to

$$A\left(\frac{q_0}{\tau_{cr}}\right)\tau_{cr} = 3.0\,\tau_{cr}\,A$$

where A is the contact area of the indentor. Assuming this contact area to be constant, then it is readily seen that for positive K values (tension) the load necessary to initiate plastic flow decreases, while for negative K values (compression) it would increase. These observations are confirmed qualitatively by the test results of Blain (3).

If it is now assumed that a lower load for initiation of plastic deformation would ultimately result in a greater extent of plastic deformation as a constant load is applied, then it follows that the final hardness must be decreased when tension stresses are present; conversely, an increase would result if compressive stresses are present. Thus materials appear to become softer under tension and harder under compression.

Steel in Tension

Mild steel (SAE 1020) specimens (Fig. 2) were annealed and carefully machined to retain flatness and minimize machining stresses. The specimens were then loaded in a portable test fixture in axial tension. The fixture and specimen are shown in Fig. 3. All stresses were induced in the specimens prior to making hardness measurements. Fig. 4 shows a typical hardness (Rockwell 30T) versus tensile stress curve.

If the initial yield strength is exceeded, the instantaneous yield stress of the test piece (or flow stress) will also increase which in turn should be reflected by higher hardness readings. Fig. 5 shows the results of hardness measurements under load and no load as the specimens were prestrained by stretching to various values. All points are averages of five or more hardness readings. The fact that hardness readings under load show some scatter may be attributable to creep or nonuniform plastic deformation. These tests were performed on independent specimens, however, and the scatter of test results may also be due to material variation.

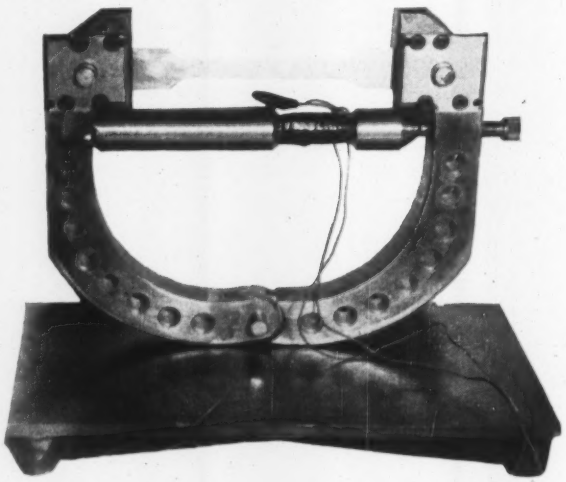
In order to test if an increase of hardness is obtained when a test specimen is under compressive loading, 2-in. diam annealed commercially pure aluminum (1100-0) was subjected to combined compressive loading. This was accomplished by subjecting the specimen contained in a steel chamber to an axial load of approximately 80,000 psi and then releasing the axial load before making hardness tests. In this way the springback of the retaining cylinder induces biaxial compression in the test bar.

The results are shown in Fig. 6 as hardness surveys across the 2-in. section. The surface of the specimen was evidently subjected to some plastic deformation, since the hardness after removal from the chamber was higher than the initial hardness in the annealed state, and the annealing treatment was incomplete. The results appear to confirm Kokubo's results that compressive stresses are less effective in altering the hardness of the material than are tensile stresses.

Gradient Stress

Another series of hardness tests was run on tensile and compressive stresses induced in a bent mild steel strip, $^1/_4$ in. thick by $^5/_8$ in. wide by $7^1/_2$ in. long. These

Fig. 3 The portable loading device, showing a test specimen in position. The load is applied through a jackscrew, with a strain gage to determine the amount of the induced tension. The whole assembly can be carried to a Superficial Rockwell hardness tester and supported on a fixture to insure proper positioning of the test bar on a $^1/_4$-in. diam anvil.



strips were machined and then bent plastically to various radii. They were then annealed in the deformed state and descaled by an acid dip. The specimens were then mounted in a bending fixture in which bending moments could be applied until the specimens were again straight. Hardness readings were taken on both sides of the specimens.

The object of these tests was to evaluate hardness changes in the presence of stress gradients, but without subjecting the test section to curvature while under load. The results are given in Fig. 7. They indicate that the decrease in hardness on the tension side is generally larger than the increase on the compression side, which again confirms Kokubo's results.

Comparison with results of Fig. 5 also shows that the decrease in hardness due to tensile stresses, when stress gradients are present, is apparently smaller than it would be if uniform stresses of the same magnitude exist in the test piece. The fact that the stresses in the elastically bent beam (10 ft bend radius) show a different trend than that in the plastically bent beams is not explained, but may be due to a shift in the neutral axis during plastic deformation.

A final series was run on an annealed mild steel specimen, loaded in pure tension to a magnitude of the yield point stress in the previously mentioned test fixture, and then subjected to Scleroscope hardness tests. It was found that the hardness readings under load and under no load were substantially the same; hence impact hardness readings do not appear to be affected by residual tensile stresses in mild steel.

Conclusions

1 Penetration hardnesses in annealed mild steel decrease substantially in the presence of uniform tensile stresses. The greatest decrease in hardness occurs when the tensile stress is at the yield point of the steel.

2 Biaxial compressive stresses of magnitude of the yield point stress of annealed commercially pure aluminum appear to increase the hardness only slightly.

3 Induced bending stresses in annealed mild steel, when tested in such a way that the specimens had zero curvature, showed generally that the hardness on the tension side dropped more than it increased on the compression side. It also showed that differences in hardness are smaller when tensile stress gradients of the same magnitude as uniform tensile stresses are present.

4 Scleroscope hardnesses are not affected when annealed mild steel is subjected to tensile stresses of yield point value.

Acknowledgment

The authors wish to acknowledge support received in carrying out the investigation from the National Science Foundation (Grant NSF G2957) and from the University of California. They wish also to thank Mr. C. Lockrem for his valued assistance in the construction of experimental apparatus.

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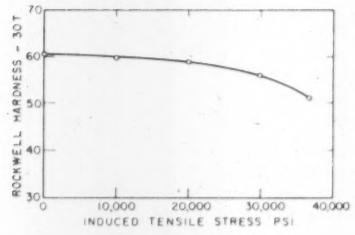
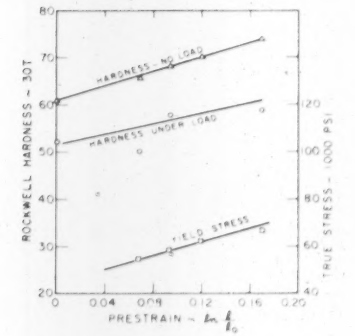


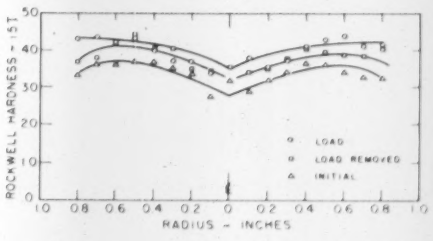
▲ Fig. 4

Fig. 4 The hardness curve (Rockwell 30T) for annealed mild steel under uniform tensile stress. As the tensile stress increases, the hardness decreases approximately linearly in the elastic region. It departs from linearity as the yield strength of the material is approached.



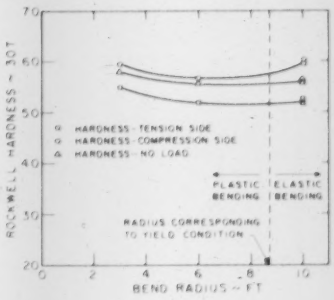
◀ Fig. 5

Fig. 5 Hardness variation of annealed SAE 1020 steel under load—and also with no load—for various amounts of tensile prestrain. Instantaneous yield strengths and no-load hardness are seen to rise with increasing prestrain. Hardness under loads corresponding to instantaneous yield stresses or flow stresses, increase with increasing prestrain.



▲ Fig. 6

Fig. 6 Results of tests for hardness under compressive loading. Commercially pure aluminum was subjected to compressive loading by causing a steel jacket to press radially against it. The increase in hardness was relatively small, due to the fact that residual stresses were of the order of 10,000 psi or less.



▶ Fig. 7

Fig. 7 A series of hardness tests on mild steel strips first bent to various radii, then annealed, and finally mounted in a fixture for application of bending moments to straighten them. In this way, bending stress gradients were established without curvature. The radius of curvature plotted is that of the annealed specimen before the application of load.

Coefficients of FLAT-SURFACE FRICTION

With the development of automatic machine tools and new material applications—particularly to sliding components—additional and more accurate information on the frictional behavior of flat sliding surfaces is required

Since interrupted motion is involved, the friction forces which must be overcome in sliding have a range of values under conditions of kinetic friction

By A. O. Schmidt[1] and E. J. Weiter[2]

ACTUAL profiles of machined flat surfaces show that they are composed of large numbers of peaks (asperities) and valleys. The asperities vary in size, shape, number, and location depending on the physical properties of the material and the method of finishing. Referring to Fig. 1, it is evident that there is no similarity of the asperities on a given surface.

Mechanics of Friction

A brief review of the generally accepted mechanism of friction will indicate the importance of the asperity. The friction force, either static or kinetic, is the summation of the force necessary to shear the welded contact areas, the force required to plough the asperity of the hard material through the soft material, and the force needed to overcome interlocking of asperities. This can best be seen in Figs. 1 and 2 which show actual surface profiles. Where direct contact of asperities is made there is a probability of at least partial welding.

When the sliding surface consists of a flat surface, the random location and geometry of the asperity become important. There is also a relationship between friction and the hardness of the materials (1),[3] since the hardness is a measure of the capacity of the bulk material to withstand shearing. In addition, the true contact area is a function of the normal load and the hardness, in the case in which two flat surfaces are brought into contact. The number of contact areas is dependent on the actual surface profiles, and these areas are random in location. Their number and size can be correlated with the flow hardness of the materials (2, 3).

The contact area is also proportional to the load (1, 2). The asperities in initial contact must deform elastically and plastically until contact area is sufficient to carry the load. These analyses are applicable when confined to a single asperity. However, due to the random location and geometry of the asperities composing the interface in flat-surface sliding, the load-carrying asperities may be adjacent, especially when waviness is present on one of the surfaces. When load-carrying asperities are confined, Fig. 3, resistance to elastic and plastic deformation will differ.

The extrusion of lubricant from the interfaces of flat surfaces as load is applied is a function of the geometry of the available flow paths. This may vary from unrestricted flow to complete entrapment.

Coefficients of static friction are generally given for steady-state conditions which implies that these coefficients are independent of time. However, the time the contacting surfaces are at rest, prior to sliding, produces changes at the interface which will affect the coefficient of static friction (2). Since plastic deformation in the form of creep appears to take place in varying degree in all materials, static friction increases within limits, with respect to the time the contact area has been at rest under load, prior to breakaway. This increase of friction would be the result of the enlargement of area, both in size and number of asperity junctions, as well as the accompanying increase in interlocking.

At the instant two flat sliding surfaces are brought to rest, the asperities are subjected to stresses in excess of those necessary to initiate plastic deformation.

After initial deformation has taken place the stresses are lower. This introduces a time rate of stress loading. Recent basic research in the area of microcrystalline behavior has opened to question the validity of classifying a substance as ductile or brittle. Determination of ductility or brittleness should rather be based on the ratio of the cohesive stress to the shear stress present; determined by the rate of loading, and the stress pattern. Therefore brittleness and ductility are not inherent properties of a material (4).

[1] Research Engineer, Kearney & Trecker Corporation, and Research Professor, Marquette University, Milwaukee, Wis. Mem. ASME.

[2] Assistant Professor, Mechanical Engineering, Marquette University, Milwaukee, Wis.

[3] Numbers in parentheses refer to Bibliography at end of paper.

Based on two papers by the same authors, entitled "Flat-Surface Friction Apparatus," ASME Paper No. 57—SA-48, and "Coefficients of Friction of Flat Sliders," ASME Paper No. 57—SA-100, contributed by the Research Committee on Metal Processing and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9-13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Fig. 1 Interface formed by two surface profiles. (1 Asperity contacts where welding can occur. 2 Interlocking of asperities and valleys.)

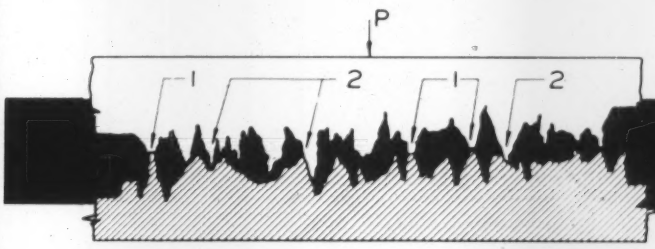
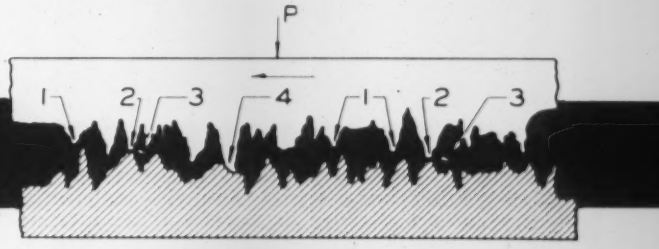


Fig. 2 Change at interface due to initial motion. (1 Sheared welds. 2 New welds. 3 Loose wear fragments due to interlocks. 4 Ploughing.)



as well as under those of static friction. Therefore, it is desirable that all the frictional characteristics of the sliding surfaces be known. The goal of this investigation was to establish the coefficients of static friction, as well as the "breakaway," and kinetic behavior of selected material combinations.

An inclined-plane system and slider constitute the basic apparatus needed to obtain static coefficients of friction. An electrical resistance wire suspended from fittings at the end of the slide, which is basically the variable leg of a Wheatstone-bridge circuit, provides a record of the position of the slider with respect to time. Analysis of the time-position record permits determination of the kinetic coefficient of friction.

Although steady-state static friction is related to Brinell-hardness number, it should also be considered to vary with the time at rest. When this is less than 2 min, the authors' tests indicate that the effect of confined asperity deformation, and the time rate of stress application become a factor. When the time at rest is extended, the increase in static friction due to atomic migration should be included.

Existence, at the interface, of a foreign film, such as a lubricant, introduces another time-dependent variable in the static friction consideration—namely, the film extrusion.

The coefficients of friction for two sliding flat surfaces depend on the intricate combination of factors that establish the interface conditions. To obtain these coefficients from tests run on a friction apparatus, care must be taken to provide similarity. It is the authors' opinion that geometric as well as dynamic similarity must exist to validate frictional predictions. A friction test in which geometric similarity is sacrificed in search of consistency places the sliding conditions in a definite category. Errors will occur in application of friction data to sliding conditions different from the conditions under which the data were obtained. The magnitude of the error encountered will be proportional to the degree of dissimilarity of the interfaces.

Friction tests performed with pairs of nominally flat surfaces will be geometrically similar to the friction in machine slides; since the distribution, location, and number of actual contact areas, as well as configuration, will be similar. In addition, the effects of confining the interface will be contained in the data. Thus the friction data obtained when flat surfaces are used will include the effects of confined elastic and plastic deformation of the arbitrary contact areas, as well as the behavior of the surface films. The magnitude of the error introduced when geometric similarity is omitted varies for different sliding conditions. Lubricated surfaces will produce the largest discrepancies.

The friction data obtained with the flat-surface apparatus, Fig. 4, compare exceptionally well with the friction observed in machines. The friction-test device presented in this paper is not considered a replacement, but rather an addition to the point-contact-type apparatus.

Flat-Surface Friction Apparatus

The flat-surface friction apparatus, shown in Fig. 4, incorporates an inclined plane and nominally flat contact surfaces. The inclined plane consists of a flat surface pivoted at one end while the other end is elevated by a pneumatic cylinder. The pneumatic circuit has the necessary components to vary the rate of rise, and accordingly, the force-application rate. The angle the inclined flat surface forms with the horizontal plane is read on a calibrated quadrant. The relationship of this angle θ, to the coefficient of friction μ, is generally expressed as $\tan \theta = \mu$. The slider 3, Fig. 5, has two coplanar rectangular flat surfaces which constitute the contact area between the inclined plane and the slider. The slider is fitted into a saddle from which a free-swinging rod is suspended and contact loading is accomplished by addition to the rod of dead weights usually of from 10 to 50 lb, but more or less if necessary.

Dimensions of the units shown in Figs. 4 and 5 are as follows: Slide—4 in. wide by 30 in. long; two slider contact areas—each $^1/_4$ in. wide by 2 in. long; displacement of contact areas from base material—$^1/_{16}$ in.

The inclined-plane system and the slider constitute the basic apparatus needed to obtain static coefficients. However, with the addition of an electrical-resistance wire suspended from fittings at the ends of the slide, a record of the position of the slider with respect to

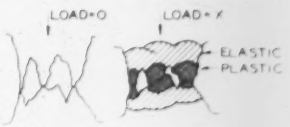


Fig. 3 Adjacent load-carrying asperities—confined deformation

time can be obtained. Analysis of the time-position record permits determination of the kinetic coefficient of friction. Basically the suspended wire is the variable leg of a Wheatstone-bridge circuit. A carbon contactor attached to the slider in trolley fashion yields a linear relationship between resistance and position. The output from the bridge is fed to a suitable amplifier and, in turn, to an oscillograph recorder. The additional frictional resistance between the carbon contactor and the resistance wire is a negligible quantity in comparison to that between the slider and slide.

The use of nominally flat rectangular contact areas combined with unlimited freedom in the preparation of contacting surfaces permits simulation of the conditions present in an actual system. Thus the data obtained become applicable to design calculations with a resultant reduction in error. The simplicity of the apparatus, particularly when obtaining static-friction data, permits tests of various slider and slide-material combinations in a relatively short time under different sliding pressures from a few oz per sq in. to over 100 psi.

Selection of the material for the 30-in-long slide is limited to a certain extent by the size. However, the problem is not as important as it may seem since one of the sliding surfaces generally is established and the other is being sought. Therefore in the interest of economy, the 4 × 2-in. slider material would be the main variable.

Usually the slide will resemble the bearing surface of a machine-tool way; e.g., scraped cast iron, ground cast iron, hardened and ground steel, or any other type of way material under consideration. The slider itself can be made of a large variety of materials, either metallic or nonmetallic. Usually a bearing-surface contact area of 1 sq in. is provided, but this also can be changed easily should requirements or test results so indicate.

The apparatus had to be mounted in a manner and location such that vibrations from neighboring machines would not influence its performance. Sometimes tests were scheduled at certain hours, when other machinery in the building was not operating, in order to eliminate variations in the coefficient of friction caused by vibrations. The sensitivity of the apparatus permitted a separate study of the effect of vibrations.

Test Range

The flat-slider apparatus and accessory equipment permit comparative tests for the mutual influence of the following factors between sliding surfaces:

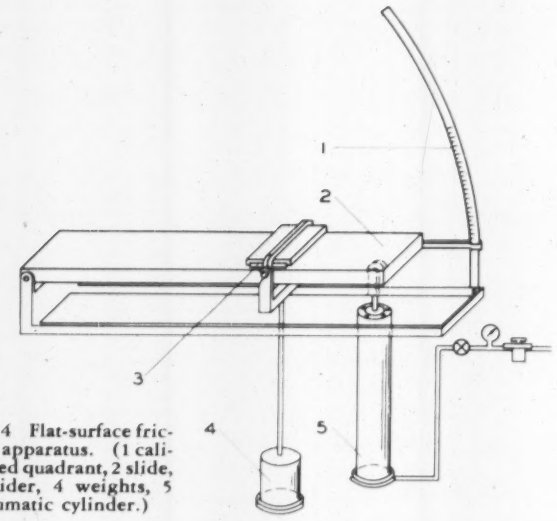


Fig. 4 Flat-surface friction apparatus. (1 calibrated quadrant, 2 slide, 3 slider, 4 weights, 5 pneumatic cylinder.)

1 Type of materials used.
2 Interface conditions of mating surfaces.
3 Lubricating agents and contaminants between sliding parts.
4 Variations caused by swell of one sliding member.
5 Surface finish changes after repeated runs.
6 Effect of vibrations upon coefficients of friction.

The flat-slider apparatus provides accurate evaluation of the coefficients of friction for those materials considered for use as actual sliding surfaces in a machine. Various bearing alloys and plastics, different lubricants, smooth and rough surface finishes (whether scraped or ground), and heavy or light loads can be checked in their interrelation under static as well as dynamic conditions.

Materials Tested

The slide materials used include: (*a*) Hardened and ground steel, (*b*) ground cast iron, (*c*) hand-scraped cast iron.

Slides *a* and *b* were finished by standard grinding to a roughness of about 20 microin., rms. Slide *c* was hand scraped, having about 20 contact points per sq in., according to generally accepted methods used in the machine-tool industry.

Slider materials included the following plastics and metals: (*a*) Formica, (*b*) Wayalloy "A" (plastic with wood filler), (*c*) bearing bronze (aluminum bronze), (*d*) ground cast iron (3.0 C; 1.8 Si; 0.9 Ni; 0.7 Mn),

Fig. 6 Coefficients of static friction on a hardened and ground steel slide vs. time at rest under load. Lub., 30-psi load.

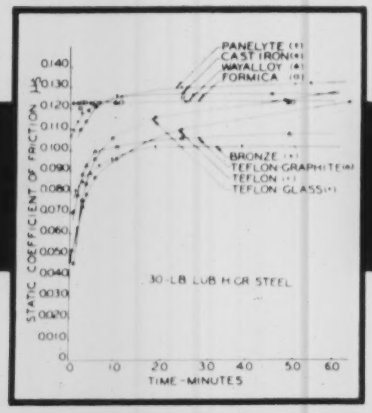


Fig. 7 Coefficients of static friction on a ground cast-iron slide vs. time at rest under load. Lub., 10-psi load.

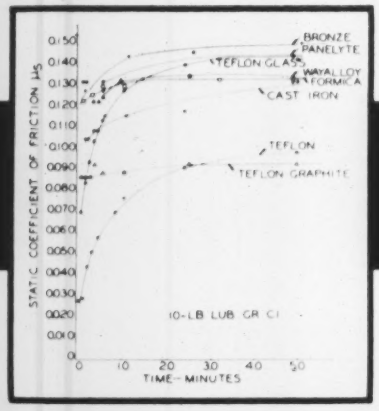
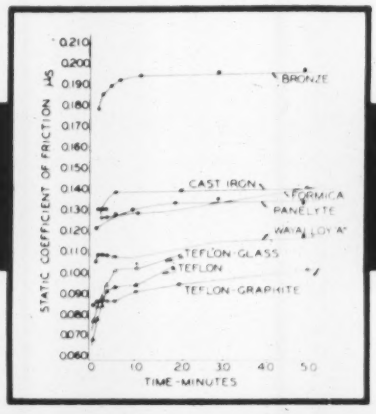


Fig. 8 Coefficients of static friction on a scraped cast-iron slide vs. time at rest under load. Lub., 30-psi load.



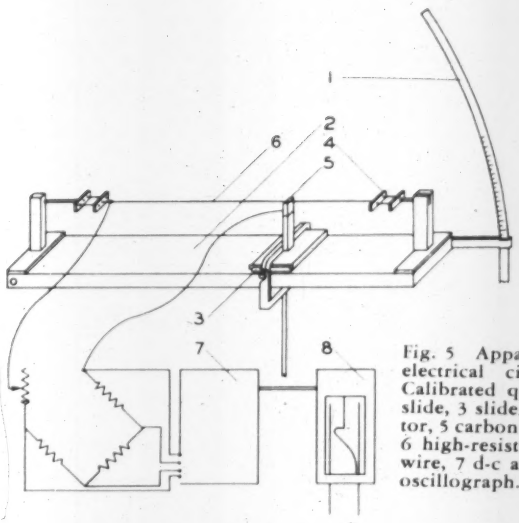


Fig. 5 Apparatus with electrical circuit. (1 Calibrated quadrant, 2 slide, 3 slider, 4 insulator, 5 carbon contactor, 6 high-resistance slide wire, 7 d-c amplifier, 8 oscillograph.)

(*e*) Panelyte, (*f*) glass-filled Teflon,[4] (*g*) Teflon, (*h*) graphite-filled Teflon.[5]

Formica[5] and Panelyte had been in storage for several years. Each of the slider materials was finished by grinding to approximate the finish on the slide, that is, about 20 microin., rms. No heat was applied to the plastic materials in attaching them to the slider mount since this would have influenced the wear and sliding properties (5).

Procedure

The preparation of the metal slide and sliders consisted of washing the contact surfaces with carbon tetrachloride. The plastic sliders were washed in a solution of a standard detergent and water. In all lubricated tests an oil, recommended for use on machine-tool slides, was applied to the slide surface with a felt applicator.

The coefficients of static friction shown in Table 1 and in Figs. 6 to 11 were obtained in the following manner:

After surface preparation, the slider was placed in the saddle on the slide, and a 10-lb weight was attached to the suspended rod. The slider assembly was then moved to a position on the quadrant end of the slide. At the instant the slider assembly came to rest a timer was started. Operation of the supply valve to the pneumatic cylinder elevated the quadrant end of the slide until the static angle, θ_s, had been reached. The timer was stopped when the point of instability had been reached; that is, the point at which the slider assembly started to move down the slide. The time read on the timer was the elapsed time at rest, and the angle θ read on the quadrant was θ_s, from which the static coefficient of friction μ_s was obtained.

Each material pair was run, keeping the time at rest constant, until stabilization of the static coefficient with respect to initial wear had been obtained. Subsequently the time at rest was extended by delaying the elevation of the slide for intervals of 0.1, 0.2, 0.3, 0.5, 1.0, 2.5, and 5.0 min with a minimum of three tests at each interval. Various long-time tests at rest under load for periods of from 1.0 to as much as 144 hours were run whenever possible.

The same procedure was repeated using a 30-lb and 50-lb load for each slider material on each of the three slides. Whether the load was applied on the suspended rod or directly on top of the slider, the frictional data obtained were identical.

The initial constant-time-at-rest tests and the subsequent extended-time-at-rest runs, respectively, permitted investigation of the relation of static friction to initial wear and to time at rest (see Figs. 12 and 13).

In the lubricated tests, lubricant was redistributed with a felt pad between each run to achieve a degree of uniformity throughout the lubricant film. Both the slides and the sliders were also cleaned and relubricated between each load increment. There is a general decrease of friction values when lubrication is applied (6).

Time and Wear

By maintaining constant the time at rest under load, the effect of initial wear was observed. As wear progressed in a pair of materials, the coefficient of static friction varied according to one of the following patterns: initially decreased and became stable; initially increased and became stable; or remained unchanged. A tabulation of the change in μ_s with initial wear is shown in Table 2. Pairs of materials for which μ_s is listed as decreasing with initial wear followed a pattern similar to that exhibited by Panelyte on hardened-and-ground steel lubricated, Fig. 13; and for those with μ_s listed as increasing, Fig. 12 is typical.

Referring to Fig. 12, it can be noted that the change of μ_s with initial wear can be substantial, up to 100 per cent in some cases. For example, μ_s, for the Formica tested dry on hardened and ground steel with a contact load of 30 psi, was 0.146 in. the first test, 0.140 in. the third and

[4] Furnished by Sparta Manufacturing Company, Dover, Ohio.
[5] End-grained Formica.

Fig. 9 Coefficients of static friction on a ground cast-iron slide vs. time at rest under load. Dry, 50-psi load.

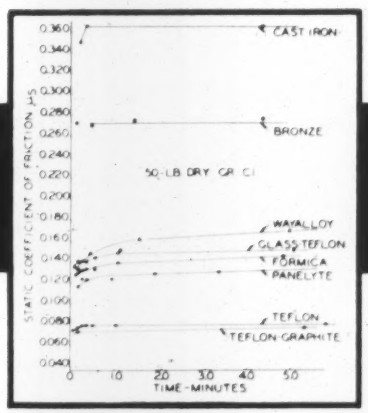


Fig. 10 Coefficients of static friction on a ground cast-iron slide vs. time at rest under load. Dry, 30-psi load.

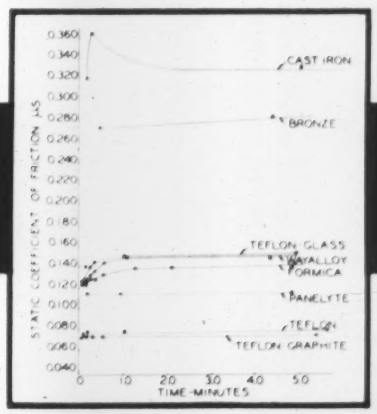


Fig. 11 Coefficients of static friction on a ground cast-iron slide vs. time at rest under load. Lub., 50-psi load.

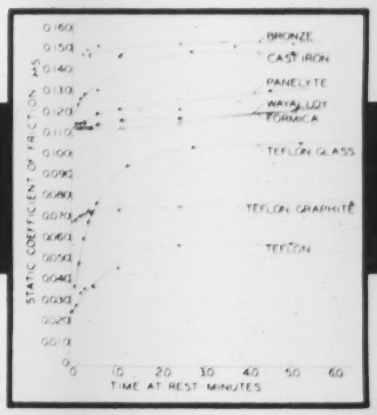


Table 1 Static Coefficients of Friction—Time at Rest, 1 Minute

		–Ground Cast Iron–			–Scraped Cast Iron–			——Ground Steel——		
		10 lb	30 lb	50 lb	10 lb	30 lb	50 lb	10 lb	30 lb	50 lb
Glass-filled Teflon	Dry	0.151	0.150	0.148	0.075	0.084	0.091	0.169	0.144	0.140
	Lubricated	0.125	0.107	0.090	0.112	0.103	0.094	0.114	0.106	0.095
Teflon	Dry	0.087	0.079	0.079	0.075	0.070	0.070	0.123	0.102	0.087
	Lubricated	0.074	0.051	0.046	0.114	0.096	0.098	0.123	0.096	0.079
Graphite-filled Teflon	Dry	0.079	0.073	0.076	0.135	0.132	0.130	0.126	0.110	0.110
	Lubricated	0.088	0.086	0.075	0.102	0.093	0.084	0.102	0.107	0.087
Formica	Dry	0.129	0.136	0.139	0.112	0.119	0.123	0.151	0.222	0.220
	Lubricated	0.130	0.118	0.114	0.137	0.130	0.130	0.124	0.123	0.123
Wayalloy A	Dry	0.150	0.149	0.151	0.098	0.105	0.105	0.148	0.164	0.194
	Lubricated	0.132	0.119	0.116	0.121	0.105	0.107	0.124	0.123	0.121
Bearing bronze	Dry	0.296	0.276	0.260	0.259	0.259	0.250	0.287	0.306	*
	Lubricated	0.143	0.148	0.150	0.167	0.196	0.211	0.100	0.096	0.098
Cast iron	Dry	0.330	0.325	0.350	0.169	0.200	0.202	*	*	*
	Lubricated	0.114	0.123	0.142	0.140	0.144	0.130	0.114	0.126	0.123
Panelyte	Dry	0.119	0.114	0.123	0.114	0.105	0.114	0.167	0.171	*
	Lubricated	0.135	0.130	0.123	0.146	0.132	0.132	0.128	0.126	0.127

* Denotes increasing coefficient on successive tests.

fourth tests, and 0.210 in. test 47, a stable value of 0.212 being obtained in subsequent tests. Initial wear for a given material varied with respect to the magnitude of the load. The data plotted in Fig. 12 typically indicate that initial wear increased with an increase in load. After this sequence of tests had been completed with the 50-lb load; it was not possible, with the same slider, to repeat the test with the 10-lb load and obtain the low coefficient of friction as before. With the same pair of slider-slide materials, the coefficient of friction was nearer 0.19 in further tests with the 10-lb load. It should also be mentioned that the wear which occurred in the tests with 30-lb loads influenced the data for the 50-lb load tests. Addition of a lubricant tends to reduce initial wear, and consequently the degree of change in μ_s with initial wear. Initial wear is still present as indicated for Panelyte on hardened-and-ground steel, lubricated, under a 30-psi load, see Table 2 and Fig. 13.

Regarding continued change in μ_s with progressive wear, cast iron and bronze exhibited the most marked increase. This was most pronounced when the tests were run dry. With the harder plastics, such as Panelyte and Wayalloy "A," μ_s also increased with continued dry testing.

The changes in μ_s with respect to the wear produced by successive tests can be attributed to surface changes such as those caused by material transfer. Changes in the slide surface can be analyzed by comparing the surface profiles. Material transfer was visually observed in inspections of the slide and slider.

With certain material combinations, the coefficient of static friction attained a stable value after initial wear, and it was noted that μ_s for these materials increased as the interval at rest under load was increased. The curves shown in Figs. 6 to 11 indicate an initial change in μ_s for intervals at rest of from 1.0 to 1.5 min with a smaller rate of change in μ_s for intervals from 1.0 to 5.0 min. Extended periods at rest ranging from 1 to 48 hr indicated increases in μ_s but at smaller rates.

Teflon-base materials exhibited the largest rate of change in μ_s with time at rest. For lubricated Teflon under a contact load of 30 psi, the rate of increase in μ_s for intervals at rest of 0.1 to 1.0 min was 2.50×10^{-2} per min; for 1.0 to 5.0 min it was 5.10×10^{-3} per min; and for 5 to 75 min it was 2.80×10^{-4} per min. When the behavior of Panelyte, which is representative of the harder plastic-bearing materials, was tested under lubrication with a contact load of 30 psi, μ_s changed at a rate of 1.88×10^{-2} per min for intervals at rest of 0.1 to 1.0 min, 7.50×10^{-4} per min for 1.0 to 5.0 min; and 7.00×10^{-5} for 16 hr. The plastics exhibited the largest rate of increase in μ_s with increased time at rest. Aluminum bronze and cast iron also showed a tendency for μ_s to increase when at rest for prolonged time.

The addition of a lubricant increased the effect of time at rest. The curves shown in Figs. 6 to 11 illustrate that μ_s in the lubricated tests varied to a greater extent than in the dry tests, and that increases in load decreased the variation. This is logical, since, in the lubricated tests, extrusion of lubricant from the interface occurred in addition to the plastic deformation and atomic migration present in the dry tests.

Fig. 12 Wear progresses in successive tests using a Formica slider on a hardened and ground steel slide. All tests were run dry. 1—50-lb load; 2—30-lb load; 3—10-lb load. Dashed lines indicate extended time at rest. Test sequence: a) 10-lb load; b) 30-lb load: and c) 50-lb load.

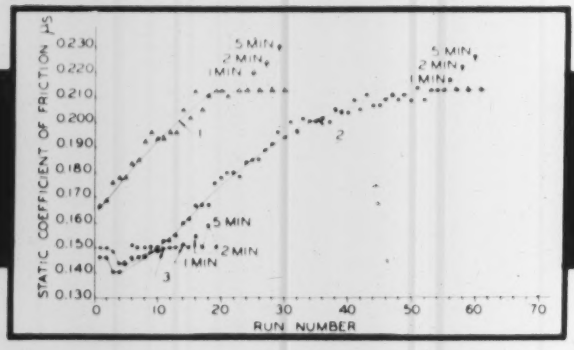


Fig. 13 Influence of initial wear on coefficient of static friction. Wear progresses with successive tests using a panelyte slider on a hardened and ground-steel slide. Upper —dry; lower—lubricated. Load, 30 lb per sq in. Dashed lines indicate extended time at rest.

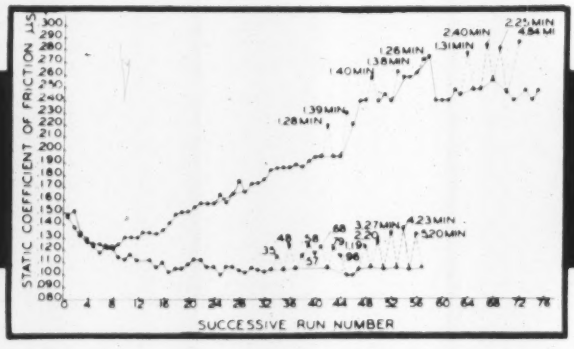


Table 2 Effect of Wear on the Static Coefficient of Friction

		Initial	Continued	Stability of μ_s
Formica	Dry	+	0	Fair
	Lubricated	−	0	Good
Wayalloy	Dry	+	+	Poor
	Lubricated	0	0	Good
Bearing bronze	Dry	+	+	Poor
	Lubricated	+	+	Poor
Cast iron	Dry	+	+	Poor
	Lubricated	+	+	Poor
Panelyte	Dry	−	+	Poor
	Lubricated	−	0	Good
Glass-filled Teflon	Dry	+	0	Fair
	Lubricated	+	0	Good
Teflon	Dry	+	0	Good
	Lubricated	0	0	Good
Graphite-filled Teflon	Dry	0	0	Good
	Lubricated	−	0	Good

Each material combination produced different rates of change in μ_s mainly because of the difference in surface conditions. Teflon-type materials exhibited the largest rates of change in μ_s because of the low yield strength of Teflon. This can be accounted for by the restricted extrusion of lubricant as a result of the conforming of the plastic to the surface irregularities of the metal slide. In contrast, the metals, having greater yield strength, would better maintain original surface profiles and thus provide for a less restricted extrusion of the lubricant. The harder plastics are intermediate, because of yield strength lower than cast iron or bronze, but higher than the Teflon-type plastics.

Surface profiles and plastic yield stresses of the materials account for the difference in the rate of change of μ_s with time. Those materials with low strength, such as the Teflon group, deformed plastically to conform to the surface profile of the slide. For lubricated tests, this mating of the surface would provide maximum resistance to extrusion of the lubricant, while the materials with higher strength such as Wayalloy would maintain a surface profile which would tend to remain unchanged, and provide a lower resistance to lubricant extrusion. Accordingly, with bronze and cast iron the extrusion resistance would be minimum.

The breakaway characteristic of a material is dependent on the difference between the static and kinetic friction. An analysis of the recorded time-displacement diagram with regard to velocity and acceleration by graphical differentiation is shown in Fig. 14. The explanation of this graph includes d'Alembert's principle of dynamic equilibrium. The apparatus used is an inclined-plane system as illustrated in Fig. 16.

There is no motion when

$$W \sin \theta < \mu_s W \cos \theta$$

A point of instability and impending motion is reached when

$$W \sin \theta = \mu_s W \cos \theta$$

As soon as the slider begins to move, the kinetic coefficient of friction μ_k exists instead of the static coefficient μ_s but simultaneously with a force F because

$$W \sin \theta - \mu_k W \cos \theta = F = \frac{W}{g} \frac{d^2s}{dt^2} \quad \text{or}$$

$$\sin \theta - \mu_k \cos \theta = \frac{1}{g} \frac{d^2s}{dt^2}$$

Since $a = \dfrac{d^2s}{dt^2}$, and solving for μ_k

$$\mu_k = \tan \theta - \frac{a}{g \cos \theta}$$

However, $\tan \theta = \mu_s$ therefore,

$$\mu_k = \mu_s - \frac{a}{g \cos \theta}$$

From the acceleration curve the value of the acceleration at any point can be obtained for use in the equation to determine the kinetic coefficient of friction, μ_k.

An interesting phenomenon was obtained in the analysis of the time-displacement charts. The materials exhibited velocity variations which in turn indicated negative accelerations. From the dynamic equilibrium equation, a deceleration would require a kinetic coefficient of friction higher than the static coefficient of friction. Although this is contrary to most of the current friction theories, accuracy checks on the system only confirmed this phenomenon. Further investigation of this behavior is warranted.

However, it is often found when taking power data on machine-tool drives that there is an instantaneous power increase. This can also be experienced in cranking the handwheel of a machine-tool slide with one hand, when suddenly both hands are required to overcome a "rough spot" or "sticking." The generally accepted explanation is usually "poor fit" or "lack of lubrication" or "loose particles." These test results indicate that there is not just one value of μ_k for flat surfaces, but that it is

Fig. 14 Kinetic characteristics of a cast-iron slider on a hardened and ground steel slide. Lub., 10-psi load, θs = 7 deg. An analysis of the recorded time-displacement diagram with regard to velocity and acceleration is shown by graphical differentiation.

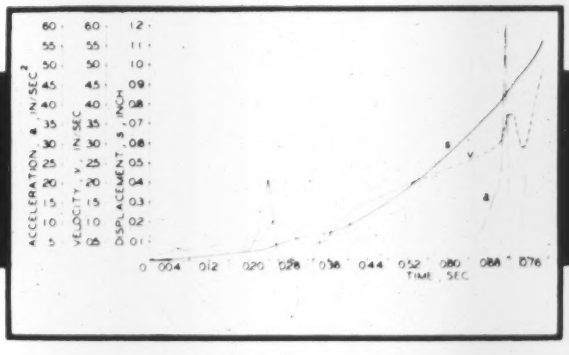
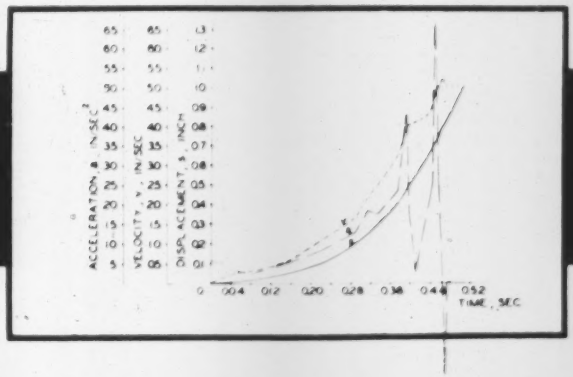


Fig. 15 Kinetic characteristics of a Panelyte slide on a hardened and ground steel slide. Lub., 10-psi load, θs = 7.3 deg. This is an analysis similar to that shown in Fig. 14 where graphical differentiation is used to show the record time displacement.



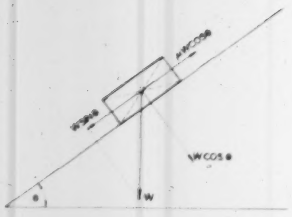


Fig. 16 Free body diagram of slider on inclined slide. The friction force, $\mu W \cos \theta$, acts on the bottom surface of slider.

possible for the slider to operate under a situation in which μ_k momentarily is larger than μ_s. An increase with speed in the coefficient of friction was found by Boyd (7) in testing S-Monel stationary sliders against stainless steel, operating under continuous-slide conditions.

Burwell and Rabinowicz (8) reported tests which showed that the friction force is a function of the normal load and the sliding speed. Speed has an effect upon the friction force due to the shear strain developed in the vicinity of the welded junction, and also because of the time required to form a junction of higher strength.

When measuring the coefficient of friction in relation to the distance of sliding, Rabinowicz (9) established values for μ_k near or equal to μ_s for copper on copper, mild steel on copper, and mild steel on titanium under dry and lubricated conditions.

The experimental evidence provided by I-Ming Feng (10) in tests on metal transfer and wear has been substantiated by the investigation reported here. Roughening of the interface due to plastic deformation, the matching and interlocking of the interface, and the effect of regions of severely strain-hardened metal near the interface will contribute to the observed variations of the coefficients of friction.

Summary

The results in this paper are based upon 2800 individual tests exclusive of preliminary tests.

Utilization of the flat sliding-surface apparatus has yielded information on the effect of initial wear and time at rest on the coefficient of static friction. Time-displacement records provide a means of analyzing the breakaway and kinetic friction.

Acknowledgment

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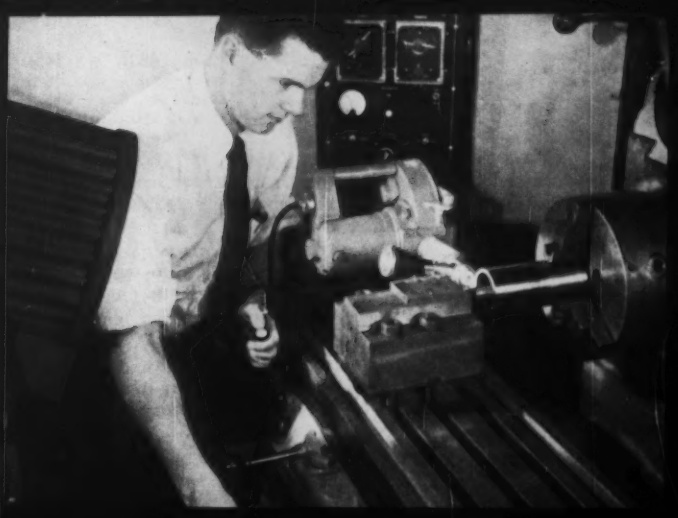
The frontiers of empirical knowledge about machining practices have been pushed back to the point where the types of problems which industry now faces require a unified attack on fundamentals, both basic and applied, by all of the physical sciences coupled with engineering



▶Fig. 1 High-speed motion-picture camera setup, capable of taking pictures of an area as small as 0.030 × 0.050 in. at 8000 frames per sec, in investigations of the geometry of chip formation

▼Fig. 2 Cylindrical grinding dynamometer and high speed recorder setup for investigation of the mechanics of the grinding process

By **M. Eugene Merchant**, Mem. ASME

Director of Physical Research,
The Cincinnati Milling Machine Company, Cincinnati 9, Ohio

Production Research in METAL CUTTING

THE MACHINING of metals is such a vital process that it can no longer be taken for granted. Actually the process is very amenable to improvement through engineering and scientific research and the application of scientific methods.

The annual direct cost of production-machining operations carried out in the United States alone exceeds $10 billion according to Hans Ernst (1).[1] Because industry is now entering an era of utilization of high-strength, high-temperature-resistant, high-melting-point metals which represent an increased level of difficulty in machining, empirical procedures no longer suffice.

Machining is an engineering process, utilizing materials and energy to produce useful goods, and as such is underlain by broad scientific principles which cut across the boundaries of specific types and fields of machining. The actions occurring in the process include plastic flow and fracture, rubbing friction, heat flow and transfer, wear, mechanical vibrations, intermetallic bonding and diffusion, generation of thermoelectric voltages, and chemical reactions with the cutting fluid or environment. The understanding of such actions, and of the part they play in the metal-cutting operation, holds the key to real engineering advances in the field. Thus for metal-cutting research to be truly efficient and productive, what is required is a unified attack, both basic and applied, employing all of the physical sciences and engineering.

As a case study, the research program of the author's company is described. To insure unity of approach, the program is concentrated in a single department. Within this department, responsibility is defined for definite scientific and engineering fields, including metallurgical research, physical research, dynamics research, physical-chemistry research, and basic and applied process research in machining, grinding, and production engineering.

One important problem is that of reducing the wear of cutting tools. Its importance stems from the fact that tool wear, as such, is the prime factor controlling the cost per piece of parts turned out in any machining operation. Machining costs are composed of two parts —those determined by the time required for metal removal and those determined by the time spent on

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Research Committee on Metal Processing and presented at the Annual Meeting, New York, N. Y., December 1-6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 57—A-99.

changing and sharpening tools. As tool wear is decreased, both sources of cost decrease. In the case of metal-removal time, the benefits of reduced tool wear can be taken out in terms of increased speeds and feeds, thus lowering the metal-removal time per piece. In the case of tool-changing and reconditioning time, reduced tool wear will result in less frequent changing and sharpening of tools, reducing the time per piece charged to this. Thus reduction in tool wear, arrived at by improvements to the machining process, reduces both sources of machining costs—as such, it is a prime focal point in any cost-targeted metal-cutting-research program.

Basic Process Research

Basic process research in machining and grinding has as its purpose the development of a working understanding of the principles involved in these operations, through investigation of the nature of the mechanisms occurring there, and the manner in which these affect the processes. Thus the geometry and mechanics of these operations—the "happenings at the cutting edge"—come in for close scrutiny. The tools required for performing such detailed scrutiny are specialized scientific instruments. A few typical of these are shown in Fig. 1. The cutting-tool dynamometer combined with the specially contrived high-speed motion-picture camera permits a direct, quantitative study of the interplay of tool forces and tool-chip-workpiece geometry in machining. Out of such studies in these laboratories, in the past, has come an understanding of the mathematical relationships governing the mechanics of the process of cutting metal, by means of which the forces, stresses, and strains acting between workpiece, chip, and tool may be directly calculated from simple measurements. Thus the causes of observed behavior in machining can be directly evaluated, eliminating a "blind spot" in dealing with the process.

An example of the understanding about tool-wear causes which is obtainable through application of the basic method of analysis offered by knowledge of the mechanics of cutting is found in the study of the machining characteristics of radically different types of metal compositions. A case in point is the machining of titanium. When this metal arrived on the scene it was noted that, by conventional standards, it should machine very readily. Yet it did not. It was found that cutting tools ran very hot and thus failed rapidly. Why? Metal-cutting mechanics had shown that the temperature rise at the tool face in cutting increases with increased strength of the metal being cut, increased amount of deformation of the metal in forming the chip, decreased apparent contact area between chip and tool, increased friction force and sliding speed occurring on that contact area, and decreased specific heat, heat conductivity, and density of the work material. Measurements made on titanium showed that the strength of the metal and the friction force on the tool face were comparable to those obtained with steel of similar mechanical properties. Further, the amount of deformation in forming the chip was lower for titanium than for steel. Offsetting this, however, was an array of characteristics wherein titanium was deficient compared to steel, namely, smaller apparent contact area between chip and tool, considerably higher sliding speed of the chip on that area (for identical cutting speeds), and lower specific heat, heat conductivity, and density. Thus the sources of the poor machining characteristics of titanium were made clear, making it possible to take steps to combat these characteristics and thus to arrive at practical methods for machining this material satisfactorily (2).

Because of the success obtained by applying basic analyses of the mechanics and geometry of the cutting process, this method of attack has been extended to the grinding process. In this, the individual grits in a grinding wheel are treated, statistically, like individual minute single-point cutting tools, which indeed they are. Here again, specialized, sensitive instrumentation is required, such as the grinding dynamometer shown in use in Fig. 2. One of the first problems attacked by this method of analysis has been that of the relation of the wear of grits in a grinding wheel to the load on, length of cutting path of, and speed of motion in this path of the individual grits in a grinding wheel. It has normally been assumed that increasing any one of these quantities in a grinding operation will increase wheel wear. However, in a recently completed research project in these laboratories investigating the relation of grinding-wheel wear to the mechanics of grinding, it was discovered (3) that, under certain mild finish-grinding conditions in precision-infeed cylindrical grinding, using a relatively unreactive abrasive-metal combination (aluminum oxide and steel), the grinding ratio (ratio of volume of metal removed to volume of grinding wheel worn away) was virtually independent of chip cross-sectional area, length of grit-contact path and wheel speed, when each of these was varied independently of the other two over approximately a three-fold range. The actual ranges over which these quantities were varied, producing this surprising result, are given in Table 1. This discovery contributes in two ways to the general understanding of grinding-wheel wear. First, it reveals the fact that grinding-wheel wear, in terms of grinding ratio, need not always be dependent on the mechanical variables in grinding. Secondly, it defines an experimental climate within which the mechanisms of abrasive grain wear and cutting action may be explored without significant influences from the mechanical variables of grinding.

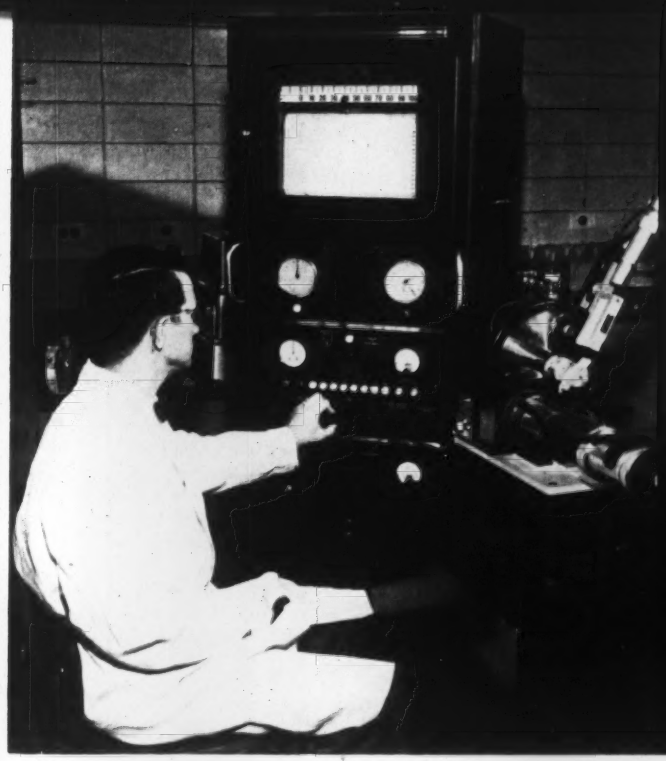
Metallurgy

Metallurgical research on the tool-wear process includes the fascinating and still-unfolding problem of the part played in this process by intermetallic diffusion at the areas where the cutting tool is in rubbing contact with the chip and workpiece. A number of investigators in recent years have found evidence to indicate that such diffusion may, in certain instances at least, be an important factor in hastening cutting tool wear in ma-

Table 1 Range of Infeed Cylindrical Grinding Variables Over Which Grinding Ratio Was Found Constant

Variable	Value when held constant	Range when varied
l_m	0.0154 in.	0.011–0.028 in.
A_m	312×10^{-10} sq in.	$150 \times 10^{-10} - 500 \times 10^{-10}$ sq in.
V	61.2×10^3 in. per min	$30 \times 10^3 - 100 \times 10^3$ in. per min

A_m = maximum undeformed chip area.
l_m = undeformed chip length.
V = peripheral wheel speed.



◀Fig. 3 X-ray spectrograph used for rapid and accurate determination of diffusion coefficients

▼Fig. 4 Autoradiographs of milling chip produced with single-tooth radioactive milling cutter, face-milling operation: Cutting speed, approximately 90 fpm; feed, 0.006 in. per tooth, depth of cut, 0.060 in. Start of cut is at left; built-up edge carried off by end of chip at right.

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chining. However, the basic metallurgical factors governing intermetallic diffusion between cutting-tool materials and various types of work materials must in themselves be better understood before real improvements in tool life through control of the diffusion process become a reality. To develop such understanding, the metallurgist has joined hands with the physicist and his tools of research. Supplementing his usual optical metallograph with the electron microscope the research metallurgist has explored the details of structure of diffusion zones formed artificially by heating common tool materials and work materials in contact in high vacuum. As a result of such studies it is becoming increasingly evident that the diffusion reactions found here can also occur significantly under the conditions existing where rubbing contact occurs between tool materials and work materials in machining. Further, the characteristics of the structures formed vary considerably with changes in composition of tool and work, and in such a manner as considerably to affect the ease with which the products of diffusion could be abraded from the tool, and carried off with the chip and workpiece surfaces.

To explore more quantitatively these diffusion processes and their potential for affecting tool wear, improved means were needed for measuring diffusion coefficients of metal pairs, to determine the rates at which they diffuse into each other. Here again the metallurgist and physicist teamed together and developed techniques whereby the x-ray spectrograph, Fig. 3, can be used to provide data on diffusion coefficients with an accuracy and rapidity which is considerably improved over that provided by most conventional methods. Details of this method will be published at a later date.

Physics

Physical research has yielded many new and valuable findings and techniques. Of the latter, one of the most rewarding of all has been the application of radioactive tracers to the measurement of tool wear and investigation of its mechanisms (4). A typical radioisotope laboratory setup is in use for tool wear measurements. With this method, by taking a cut of a few seconds duration with a radioactive tool, and measuring the radioactivity of the resulting chips, to which the tool-wear particles adhere, a quantitative measure of rate of tool wear is obtained. This simple tool-wear test, performed in a matter of minutes, yields data equivalent to that obtained in a conventional tool-wear test of several hours duration, and at the same time provides a considerably higher accuracy than is obtainable by conventional means.

Not only does the use of a radioactive tool provide greatly increased speed and accuracy in tool-life testing, but it also provides a means for investigating the nature and mechanisms of tool wear, through its ability to detect and follow the individual wear particles coming from the tool. One ready means of doing this is by autoradiographs, wherein the chip or workpiece surface is placed in contact with photographic film, allowing each wear particle to expose the film and thus take its own picture. For example, in current investigations on the tool-wear process in milling, using radioactive cutters, initial autoradiographic studies were made of the chips and milled surfaces. An autoradiograph typical of those obtained is shown in Fig. 4. It is interesting to note the initial high wear rate, evident from the chip autoradiographs, each time that the tooth enters the cut.

Further, on the chip, it can be seen that the built-up edge, which remains with the chip as the tooth leaves the cut, carries with it a very high concentration of tool-wear particles, accounting for much of the total wear occurring during the removal of the given chip. This behavior is found quite universally on milling chips taken over a wide range of cutting conditions, when a built-up edge is present.

Dynamics

One of the most useful research tools employed by dynamics research is the analog computer. Here, the mathematical description of the dynamic characteristics of the chip-tool-workpiece system in machining can be simulated electrically, and the effect of changing different variables can be studied by the simple variation of electrical characteristics of the analog-computer simulation. For example, two important dynamic factors which have a very pronounced effect on the wear of cutting tools are tool vibration, and the flow of heat in the chip-tool-workpiece system. Both of these areas require much basic study to effect further improvements in machining practice, and both are readily amenable to investigation by analog simulation.

Physical Chemistry

Physical chemistry enters into many aspects of the metal-cutting process, most of these lying particularly in the area of surface chemistry and physics. The action of a cutting fluid in machining especially involves many problems in this area. The reduction in tool wear produced by application of an effective cutting fluid to a machining operation results not only from the beneficial cooling produced by the fluid acting as a heat-transfer agent, but also from the reduction in rubbing friction brought about by very thin films of low-shear-strength solids, formed by chemical action of the cutting fluid at the rubbing interfaces between chip, tool, and work. Likewise "free-machining" constituents, such as the metal sulfides and lead, incorporated in tough metals as insoluble inclusions, reduce tool wear by a similar action, smearing as low-shear-strength films on the tool at these interfaces. Understanding of the mechanical properties of such thin films, and their ability to reduce rubbing friction when present on otherwise clean metal surfaces, is necessary if we are effectively to utilize such films to reduce tool wear. A useful instrument for such research is the high-vacuum friction apparatus of Fig. 5. Typical friction values for thin films of various solids present on the surface of drill-rod friction specimens are given in Table 2. It can be seen that FeS_2, such as would be formed by action of an effective sulfurized cutting fluid when machining steel, and MnS such as would be deposited by a sulfurized free-machining steel, are both effective in reducing the high values of friction given by metal-to-metal contact of the uncontaminated specimens. It can be seen that under comparable conditions an MnS film provided by a free-machining steel can be expected to be somewhat more effective in reducing friction in metal cutting than an FeS_2 film provided by a sulfurized cutting fluid, but both may be expected to drop off rather considerably in effectiveness as temperatures become more severe on the areas of rubbing contact on the tool. Further, studies such as this provide a base line for evaluating the relative effectiveness of these two common means of providing protective films at chip-tool-work interfaces.

Applied Process Research

Applied process research takes the findings of the basic research and applies these to the improvement of production-machining operations and practices. For example, in the field of milling, using such findings together with such new knowledge as comes from without, and investigating in the laboratory its application, with such equipment as that shown in Fig. 6, progress has been steady in the problem of reducing cutter wear, and thus obtaining higher productivity. Advances have varied all the way from developing an understanding of the proper relation of milling-cutter rake angles to the requirements of the operation (5), to a start on the problem of utilizing in the milling process the excellent wear resistance of ceramic cutting tools. In this connection it is interesting to report that considerable promise has already been found for these materials in the milling of cast iron. By application of principles arising out of the basic understanding of cutting mechanics and cutter geometry, conditions have been arrived at wherein a ceramic-toothed fly-milling cutter, operating at 2000-fpm cutting speed, is giving excellent life, exhibiting wear less than half that experienced with a similar sintered-carbide cutter. Further details will be published at a later date.

Basic principles are likewise being applied with success to the problem of improving the cutting action of drills, thereby decreasing heir wear, and improving the quality of drilled holes. Part of the instrumentation used in this study is shown in Fig. 7. This arrangement, by use of the twin spindle, provides means for running wear tests comparing two different drills under identical conditions; further, by use of the drilling dynamometer and tool-work-thermocouple instrumentation, drilling torque and thrust, and drilling temperature can be determined for either drill at any desired intervals throughout the wear test. In this investigation, the geometry of the drill point is being varied in accordance with principles drawn from the basic understanding of cutting mechanics, with the aim of providing a true cutting action, improved chip formation, and reduced heat generation. It is found that improvements of this type show considerable promise in reducing drill wear and bettering hole quality. Complete details of these findings will be published in the near future.

Production Engineering Research

Applied research in production engineering has as its aim the investigation of machining practices in production operations, particularly from the point of view of reducing costs. Tool wear, as already outlined, holds a place of prime importance in controlling these costs. As an example of the type of approach used here, consider the problem of determining the cutting speed which will give minimum cost per piece for parts turned out on a production-machining operation, that is, the determination of the economic cutting speed. As cutting

Table 2 Coefficients of Static Friction, Thin, Vacuum-Evaporated Films on Clean, Polished Specimens[a] of Drill Rod in High Vacuum

Film	Temperature, F	Coefficient of friction	Ratio, friction of coated to clean specimens
None	75	1.00	...
None	690	1.71	...
FeS_2	75	0.21	0.21
FeS_2	690	1.35	0.79
MnS	75	0.20	0.20
MnS	410	0.98	...
MnS	690	0.79	0.46

[a] Friction specimens—1/4-in-diam crossed cylinders.

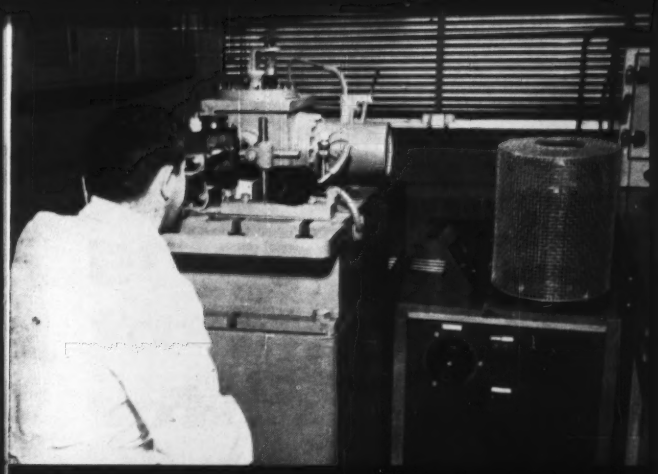

Fig. 5 High-vacuum friction apparatus for investigation of friction-reducing characteristics of thin films such as produced at chip-tool-workpiece interfaces by cutting fluids and free-machining additives

Production Research in METAL CUTTING

Fig. 6 Equipment for milling investigations, applying the results of basic research to practice

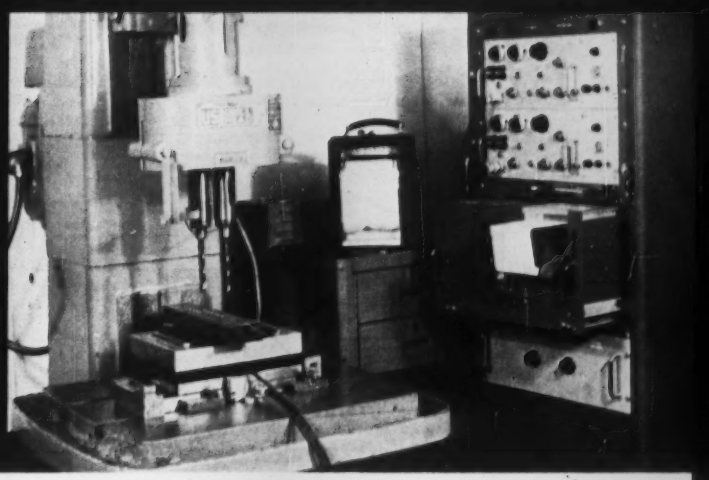

Fig. 7 Drilling setup, with dynamometer and temperature recorder, used in research aimed at improving drill geometry

speed is increased in an operation, tool wear increases, and thus more time must be spent in tool changing and sharpening per piece turned out; thus the piece cost due to these factors will *increase*. On the other hand, as cutting speed is increased, more parts are turned out per hour, so that the cost for the machining time spent on each piece will *decrease*. Thus it is evident that there must be, for each operation, a cutting speed which will result in least cost per piece. Through production-engineering research, applying metal-cutting theory, the relationships which can be used to calculate this economic cutting speed from minimum data, obtained directly on the job, have been developed in simple form and incorporated in pocket calculators, for the case of milling and turning operations.[2] With this calculator, knowing the time to change and recondition the cutter, and the tool-life time for the operation, economic cutting speed can be calculated directly.

Conclusion

In a case study such as this, it is obviously not possible to expand any one example in much detail or to begin to cover the myriad other examples possible. However, the basic method for securing productive results in modern metal-cutting research, through a unified scientific and engineering attack on broad problems, has been illustrated; it is hoped that this approach may prove helpful to industry in general.

[2] Available from The Cincinnati Milling Machine Co., Cincinnati, Ohio.

Acknowledgments

Many of the research findings have been drawn from the work of the author's associates in physical research, and he wishes to acknowledge their continuing contributions. In particular, the author wishes to acknowledge the efforts of Mr. J. L. Neu and Mr. J. C. Hawlik, Research Engineers, in the development of auto-radiographic techniques and the application of these to milling research, illustrated in Fig. 4; of Mr. G. M. Hain, Research Associate, in the findings on the friction-reducing properties of thin solid films; and of Mr. E. J. Krabacher, Senior Research Supervisor, and W. A. Haggerty, Research Supervisor, in the development of the techniques for milling with ceramics; all of the Physical Research Department. Appreciation is expressed to Miss Helen Conner for manuscript preparation.

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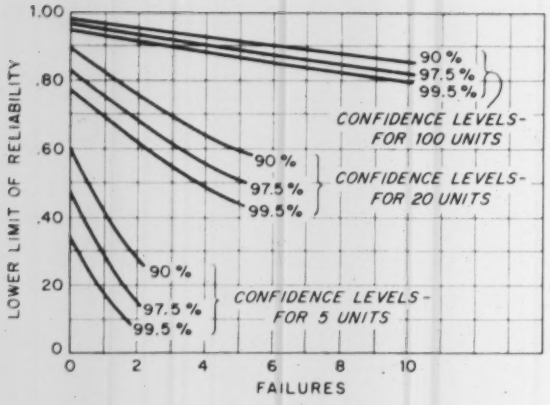


Fig. 1 Reliability versus failures for several confidence levels and for several sample sizes tested

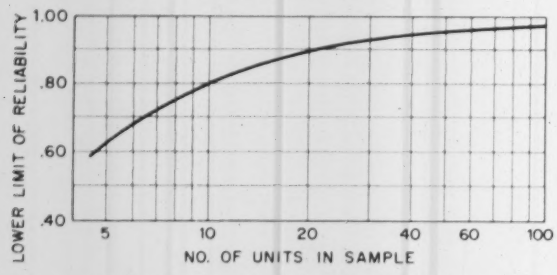


Fig. 2 Reliability versus sample size tested, for a point estimate of 0.99 from test-to-failure in increasingly severe-environment experiments at 90 per cent confidence level

Designing Equipment for Reliability

By R. B. Wilson,[1] Mem. ASME

The fields of missile and advanced aircraft design and development demand highly reliable equipment, capable of performing under a variety of severely adverse conditions. Reliability concepts are of prime importance to designers, from initial research through design and production.

Reliability of a complex system having many independent components is the product of the individual component reliabilities. In other words, if you have a device with 400 independent components, each of which is 99 per cent reliable, you have a 1.8 per cent chance of the full and proper functioning of the device at the crucial moment. This obviously untenable reliability demands that designers exercise a much higher degree of caution.

Reliability of a device is defined as the mathematical probability that it will perform its design function under the design environments within specified tolerances for the required time interval. After sufficient tests on the device, an estimate of relative reliability can be rendered, together with a level of "confidence" in the estimate, which is the probability that the true reliability lies higher than a stated minimum.

If 100 units are tested and one fails, the statistician will state with 97.5 per cent confidence, that based upon the 100-unit sample size, the reliability of subsequent samples is better than 94.6 per cent. If none had failed, however, the reliability of subsequent samples at the same confidence level is 1.8 per cent higher, that is, better than 94.6 per cent.

If 20 units are successfully tested, the reliability of subsequent samples is estimated at better than 86 per cent at the 97.5 per cent confidence level. If, for this example, we were willing to be less confident of our prediction of reliability—say 90 per cent confident, then we could raise the figure for reliability to "better than 89 per cent."

The relationship between sample size, number of failures, confidence level, and reliability is shown in Fig. 1.

System Requirements

As a start on the problem of designing reliable equipment, the designer must obviously consider the requirements of the system of which the equipment is to be made a part. These system requirements dictate the general operating specifications.

Concurrently, the designer must have a thorough understanding of the environments in which the equipment is to be manufactured, handled, transported, stored, installed, used, and serviced. The designer must give consideration to all of the following environmental conditions, selecting to the best of his ability those conditions which are applicable and in which the equipment must perform: High temperature; low temperature; temperature shock; sand and dust; fungus resistance; sunshine; corrosive gases and liquids; altitude; humidity; immersion; water spray; salt spray; explosive atmospheres; triaxial vibration; triaxial six-directional shock; triaxial six-directional acceleration; pertinent combinations of the foregoing.

[1] Senior research engineer, Reliability Group, Convair (Astronautics), A Division of General Dynamics Corporation, San Diego, Calif.

Presented at the Annual Meeting of the American Rocket Society, New York, N. Y., November 25–30, 1956; and re-presented through the Management Division, at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 57—SA-54.

General

1 Use standard, well-developed parts.
2 Select vendors whose reliability of performance is proved.
3 Simplify.
4 Establish fits and tolerances so that: (*a*) Tolerances are as wide as practical, consistent with performance requirements; (*b*) allowance is made for environments causing a widening (or narrowing); (c) allowance is made for aging causing a widening (or narrowing).
5 Reject parts out of tolerance.
6 Provide controls logically close to their corresponding displays.
7 Provide operating procedures that are reasonable for a two-handed operator and not awkward.
8 Provide adequate cooling for heat-generating equipment.
9 Provide adequate clearance between components to prevent damage during shock conditions.
10 Provide proper finish for resistance to corrosion.
11 Provide easy maintenance accessibility.
12 Use proper tools in assembling.
13 Inspect carefully after fabrication.
14 Maintain and calibrate test equipment.
15 Avoid unnecessarily rough hauling of parts.
16 Package properly for protection during shipment and storage.
17 Report malfunctions or discrepancies to proper channels.
18 See that corrective action is actually instituted.

Mechanical

1 Provide sufficient clearances for adjustment and/or travel.
2 Provide reliefs or clearances adequate for subsequent machining operations.
3 Allow for environmental changes in providing proper bearing clearances.
4 Provide assembly ramps for seals.
5 Select screws of sufficient size to hold the component in place.
6 Keep stainless-steel screws identified and separated from cadmium-plated screws.
7 Lock screws or other holding devices against loosening.
8 Secure gears to shafts with means that will not slip. Pinning is to be preferred to set screwing.
9 Provide a design that is free of points of high stress concentration.
10 See that gasket enclosure covers adequately for intended service.
11 Keep dirt, paint, and chips out of hydraulic and pneumatic components.
12 Fit parts together properly instead of jamming or forcing.

Electrical

1 Locate cable entrances where they will not be disturbed by removing access panels.
2 Provide comfortable access to terminal strips.
3 Provide extra terminals on terminal strips for unexpected needs.
4 Mark terminal strips and component boards in a permanent manner.
5 Consider environmental effect on resistors and capacitors so that there is a selection of sufficient rating, or a "derating" of the manufacturer's rating.
6 Provide adequate margin in circuits including electronic tubes to hold tube failures to a negligible rate.
7 Take account of environmental vibration which causes relays to chatter, timers to fail to function, soldered-wire joints to break, and other difficulties.
8 Stencil complete identification on outside of potted networks.
9 Protect wires and cables passing through holes in metal partitions.
10 Strip electrical wires carefully to avoid cutting strands.
11 Use only rosin-base fluxes of proved noncorrosive properties in soldering.
12 Heat soldered-wire joints sufficiently to obtain a full-strength bond.
13 Select proper production sequence. For example, a printed-circuit panel which was bent in a subsequent forming operation suffered almost invisible failure of the printed circuits.
14 Select proper insulating materials in assembly.

In a given design problem, some environmental factors relating to the application will be given by specification. The laws of variation of life with environment must be determined for each of the listed environmental factors as applied to each of the components. Then numerical values for these design requirements must be established as standards for comparison and evaluation of any proposed designs.

Overlooking one or more of the environments to which the equipment may be subjected is a common initial difficulty. All of the anticipated environments to which the equipment may be subjected from the time of manufacture to eventual discard should be considered in the equipment specifications, and customer relations and product development test personnel should be as fully and mutually cognizant of these specifications as the designer.

There are usually several potential methods of solving a design problem, and a culling process must be initiated. The one finally selected should have the greatest probability of yielding the required equipment life in the given environments, as balanced against cost, complexity, development time, available materials, and other factors. Every implied limitation should be considered, and every ambiguity amplified until resolution can be achieved—arbitrarily when absolutely necessary. All the data relating to the selected method and its aspects should be summed up in a design report. The designer is then ready to enter the actual design stage.

The accompanying list of design check-points is culled from hard-won mechanical and electrical design and production experience. Each of the points mentioned has caused difficulty at one time or another.

Search for Critical Weakness

The task is by no means over with the accomplishment of the initial design. The article must be subjected to test, and a recently fostered technique, the "search for critical weakness," is recommended. Testing is continued in increasingly severe laboratory-simulated environments until a failure or malfunction is forced, if possible. The more independent of the designer that the test organization is, the more valuable the results. Tests should be performed on sufficient samples to provide a statistical spread of information, as shown in Figs. 2 and 3. A test sequence must be chosen that will permit the largest number of environmental tests on a given unit before failure of that unit is induced; that is, the least damaging test should be performed first, and the most damaging test last.

It is generally felt that temperature, acceleration, and vibration are the most applicable environments in which it is well to test for critical weaknesses in that sequence. Electronic equipment may go out of tolerance with change in temperature, a "critical weakness," but will return to tolerance with return to normal operating temperature. Mechanical equipment may suffer a change in fit from differential expansion and contraction, but unless a damaging seizure occurs, will return to workable condition upon return to normal temperature. The same sort of analysis can apply to environmental acceleration.

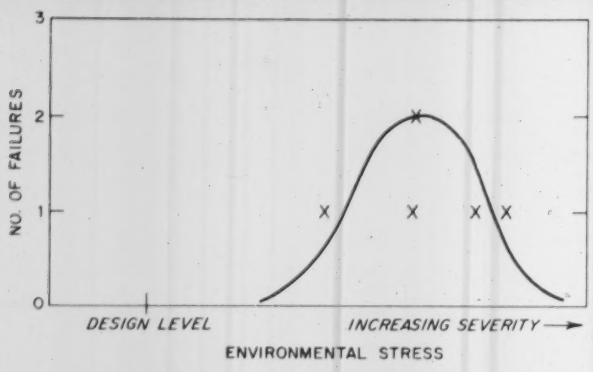


Fig. 3 Typical distribution, test-to-failure experiments

Vibration, however, is degrading, particularly where a structural member, in the interests of lightweight, is of such section that repetitive bending stresses can be imposed on it in excess of its infinite-life fatigue stress. Surface-stress fatigue life is always limited, also. Therefore vibration should be the last environment to which the samples should be subjected since degradation of the product is almost certain. Testing in two or more environmental conditions simultaneously will yield information of greater value, inasmuch as actual expected operating conditions would thus be more nearly simulated. In general, the behavior of equipment in the remaining applicable environments can be evaluated by testing one of a kind.

Analyses of Failures

Analyses of failures are of great importance in any test program. A qualified test engineer should be present at every "autopsy," if not actually performing the disassembly of equipment, in order to find the exact cause of failure. The value of a "failed-part" analysis is in direct proportion to the level of competence of the personnel involved.

In the usual development program, information on failures and malfunctions or discrepancies in the production and field tests will begin to become available concurrently with the search-for-critical-weakness test program. It is essential to set up an efficient and simple reporting system to correlate information, analyze it, and feed it back to the designer. A failure and malfunction reporting card is illustrated in Fig. 4.

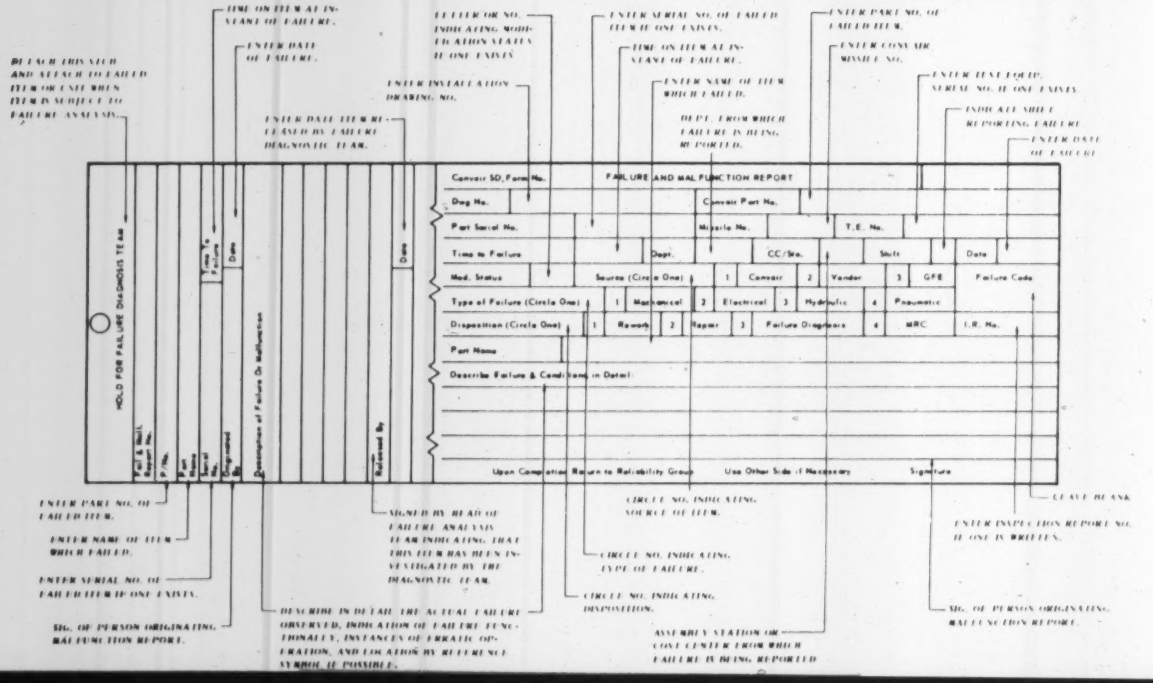
Coupled with the report of the failure or malfunction, there must be available a complete history of the equipment, itemizing any repairs or corrections made during its manufacture, the characteristics of its parts, the cumulative time of operation experienced in applicable environments, the behavior of the equipment parts at Receiving Inspection, behavior at in-process tests, behavior at final acceptance tests, and so forth.

All of these data must be collected and collated. With a rapid-sort card system, trends can be spotted, providing a warning to designers that a change in design is needed. Much valuable time can be lost by unwitting adoption of a defensive attitude by the designer. He should strive for an attitude of complete self-detachment.

Reliability concepts should be followed from initial research, through design, production, and field usage until the equipment is finally discarded as obsolete. To assist the designer in fulfilling these demands, a number of companies are incorporating a staffed reliability function within their development organization. Achievement of a highly reliable product can be more consistently assured with full co-operation between Design and Reliability Groups. The burden on the designer, however, cannot be completely shifted. His own engineering judgment must govern the direct application of reliability concepts and objectives to attain an integrated Reliability Program.

Acknowledgment. The help and encouragement of many of the Reliability Group, Convair-Astronautics, are gratefully acknowledged.

Fig. 4 Report card completed for all failures or malfunctions in addition to any other required documents


FAILURE AND MALFUNCTION REPORT
Convair SD, Form No.
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Part Serial No.
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T.E. No.
Time to Failure
Dept.
CC/Sec.
Shift
Date
Mod. Status
Source (Circle One)
1 Convair
2 Vendor
3 GFE
Failure Code
Type of Failure (Circle One)
1 Mechanical
2 Electrical
3 Hydraulic
4 Pneumatic
Disposition (Circle One)
1 Rework
2 Repair
3 Failure Diagnosis
4 MRC
I.R. No.
Part Name
Describe Failure & Conditions in Detail
Upon Completion Return to Reliability Group
Use Other Side if Necessary
Signature
HOLD FOR FAILURE DIAGNOSIS TEAM
ENTER DATE OF FAILURE.
ENTER DATE ITEM WAS RELEASED BY FAILURE DIAGNOSTIC TEAM.
ENTER INSTALLATION DRAWING NO.
ENTER SERIAL NO. OF FAILED ITEM IF ONE EXISTS.
ENTER NAME OF ITEM WHICH FAILED.
DEPT. FROM WHICH FAILURE IS BEING REPORTED.
ENTER CONVAIR MISSILE NO.
ENTER TEST EQUIP. SERIAL NO. IF ONE EXISTS.
INDICATE SHIFT REPORTING FAILURE.
ENTER DATE OF FAILURE
ENTER PART NO. OF FAILED ITEM.
ENTER NAME OF ITEM WHICH FAILED.
ENTER SERIAL NO. OF FAILED ITEM IF ONE EXISTS.
SIG. OF PERSON ORIGINATING MALFUNCTION REPORT.
SIGNED BY HEAD OF FAILURE ANALYSIS TEAM INDICATING THAT THIS ITEM HAS BEEN INVESTIGATED BY THE DIAGNOSTIC TEAM.
CIRCLE NO. INDICATING SOURCE OF ITEM.
CIRCLE NO. INDICATING TYPE OF FAILURE.
CIRCLE NO. INDICATING DISPOSITION.
ASSEMBLY STATION OR COST CENTER FROM WHICH FAILURE IS BEING REPORTED
ENTER INSPECTION REPORT NO. IF ONE IS WRITTEN.
SIG. OF PERSON ORIGINATING MALFUNCTION REPORT.
LEAVE BLANK

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*

Sputniks

THE launching into outer space by the Russians of an object a little larger than a basketball caused more consternation in the United States than the moving of the Brooklyn Dodgers to the West Coast caused in their home borough.

An aluminum alloy shell, which was about 23 in. in diam and weighed about 184 lb, Sputnik carried two radio transmitters in its nitrogen-filled interior. These 1-watt transmitters were powered by batteries which made up most of the satellite's load. They sent signals alternately, one at 20.005 megacycles, the other at 40.002.

The 18,000-mph satellite circled the earth in 96.02 min in an elliptical orbit with minimum altitudes from 150 to 400 miles and about 600 miles maximum.

Just 30 days later, on November 3, a second and larger cylindrical satellite was launched, containing a live dog. Although the dimensions were unstated, weight was a little over six times as great, 1120.29 lb; speed about the same, 17,840 mph with a 103.7-min circuit of the earth.

Overnight, the United States had lost "face" in the psychological campaign with Russia. Although government spokesmen said that timing was not an issue in the launching of earth satellites, it was! There just wasn't any getting around it.

We received some of the smarting satire which our British cousins took when they were the leaders in international diplomacy. We were complimented on our general intiellgence and ingenuity by a source newly regarded as reliable, the head of the Russian delegation in the United States; and we were congratulated by a Danish newspaper on being the first to invent a toy meteorite.

Some of our ego was recovered between Sputnik I and Sputnik II when we successfully sent a missile 4000 miles into space; but confidence in our research program had received a setback that will not be easily overcome.

Perhaps the net effect of lla this will be healthy. It is never good policy to minimize your rival, whether it be in business, politics, or international diplomacy; and we have learned that the same applies to scientific endeavor.

An official program to stimulate scientific and engineering research is presently being formulated. Already Dr. James R. Killian, Jr., president of M.I.T., has been appointed Special Assistant to the President for Science and Technology, and William M. Holaday was named Special Assistant to the Secretary of Defense for Guided Missiles.

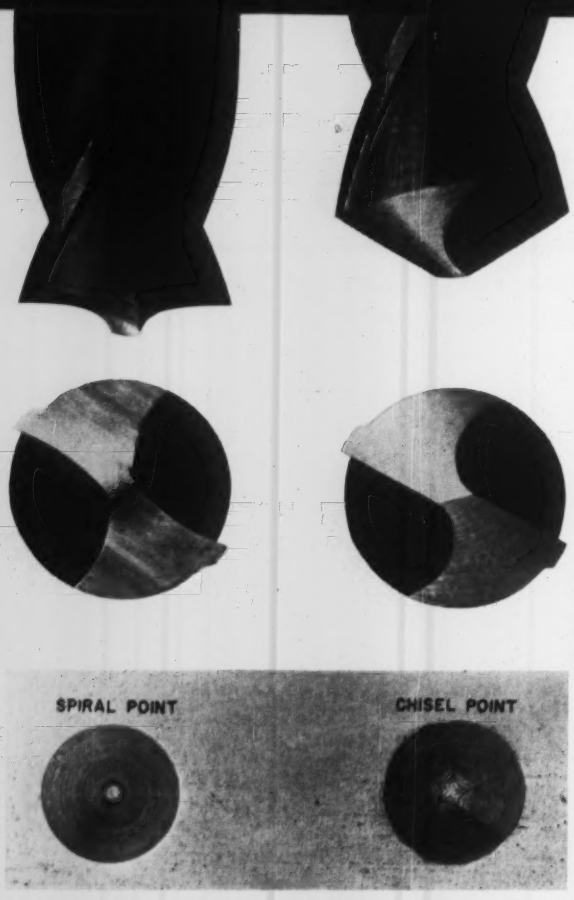
We need every bit of ingenuity that America has ever been famous for to keep us ahead, so long as we continue to gamble with the world's future on an international scale. We also need to redouble our efforts to bring about a permanently disarmed world in which nations can solve their difficulties amicably. Technology has given us advances which can mean great prosperity for all of the world. It has also given us the potential for the destruction of everything we normally label as "civilized." The choice is ours!

Comparison of Satellites[a]

	First Russian Satellite	Second Russian Satellite	U. S. Satellite (Vanguard)
Launched	October 4	November 3	Scheduled for March, 1958
Size	23 in. diam	Unstated	20 in. diam
Weight	184 lb	1120.29 lb.	21½ lb
Max altitude	560 miles	1056 miles	1500 mile (est.)
Speed	18,000 mph	17,840 mph	18,000 mph (est.)
Time to circuit Earth	96.02 min	103.7 min	90 min. (est.)
Shape	Round	Unstated	Round
Equator angle	65 deg North to South	65 deg	45 deg North to South
Visibility	Eye and telescope	Unstated	Binoculars
Radio	Silent (at present)	Silent (at present)	Plans to send meteorite and ultraviolet-ray information to Earth

[a] Courtesy *New York Times*.

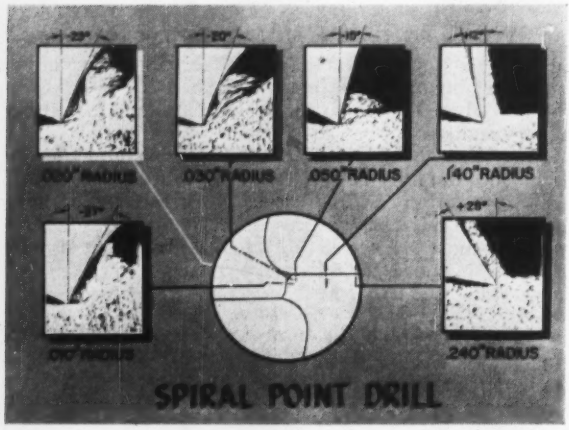
The third-stage rocket of Sputnik I, photographed with an ordinary camera, passing through the constellation of Gemini at 6 a.m., October 16, 1957, in work done jointly by the Air Force and Arthur D. Little, Inc.



Photograph of block showing comparison of roundness of hole and self-centering action of spiral point drill in contrast to erratic action of conventional chisel point

Torque and thrust values for spiral point and chisel point drills

Material	Hardness BHN	Feed in. rev	THRUST Spiral Point Measured	THRUST Chisel Point Measured	TORQUE Spiral Point Measured	TORQUE Chisel Point Measured
CMM 320	132	.004	205	310	45	40
		.007	300	410	60	75
		.010	425	500	85	95
AISI 1112	153	.004	195	290	40	40
		.007	310	410	60	55
		.010	410	510	80	80
AISI 1918	150	.004	275	350	45	45
		.007	400	485	70	80
		.010	520	610	100	115
AISI 4150	200	.004	260	350	40	45
		.007	380	490	70	70
		.010	500	610	95	105
AISI 4340	200	.004	390	490	50	50
		.007	460	575	85	85
		.010	600	750	115	125



Series of photomicrographs of sections through spiral point drill and partly formed chips, at successive points along cutting edge from axis to periphery

Spiral Drill Point

A VARIATION in drill point geometry—which has remained virtually unchanged for over 100 years—has been applied by the Cincinnati Lathe and Tool Company, Cincinnati, Ohio, to the twist drill. Termed the "spiral point," this new concept in drill design has many significant advantages over the standard chisel drill point:

1 It produces a rounder, straighter hole, which is truer to size.
2 It increases drill life.
3 It eliminates center punching.
4 It reduces drill thrust force as much as 34 per cent.
5 It produces less workpiece distortion because of cooler cutting and reduced thrust force.
6 It maintains accuracy in hole positioning.
7 It reduces the need for secondary operations, such as reaming, in many instances.
8 When applied to sheet metal, it produces a round, practically burr-free hole.

One of the greatest disadvantages of the chisel edge arises from the fact that it presents almost a straight edge parallel to the surface of the work. Consequently, it has no self-centering action when it engages the workpiece. In practice, one end is often slightly higher than the other due to small imperfections in the symmetry of grinding. As a result, the drills usually tend to "walk" to one side of the desired hole location unless restrained by guide bushings or fixtures, or by the use of a center punched hole in the workpiece.

The advantages of the new drill geometry are found at its point. The spiral point terminates at its center in a sharp point. It therefore automatically centers itself on the axis of the drill when first engaging the workpiece. Wherever the spiral point touches the work, it enters and remains in that location. There is no tendency whatever to travel or walk to one side or the other as in the case of the chisel point. Therefore it is usually unnecessary to use center-punched holes or guide bushings to maintain the proper location of a hole. In addition, the large negative rake angle found on the chisel point is greatly reduced.

Introduction of Numerical Control

THE Martin Company, one of the first in the aircraft industry to install a numerically controlled machine tool, spent more than a year of careful preparation for integration of this new concept into its engineering design and manufacturing operations.

Practically, every operation from the origin of a design on down through the production of a part was subject to radical change as described in a paper by Leon E. Laux, chief of manufacturing research and development for the Company, presented at The Third

Annual Machine Contouring Conference, Oct. 23–24, 1957, Los Angeles, Calif.

With a majority of the machine tools still under manual and template control, conventional engineering drawings and processing methods could not be completely abolished in favor of numerical control. However, the system of dimensioning engineering drawings was altered to permit more rapid translation of dimensions into numerical-control data.

Experience to date indicates that the key man in the entire materials-processing team is the manufacturing preplanner. Having a fairly good knowledge of manufacturing methods, machinery, and specific metal-cutting technology, he establishes the effectiveness of the entire numerical-control system.

Once the basic numerical plan is established for a particular part, the remaining steps of transforming the plan into a machine-control tape are fairly routine.

These include: A write-up or manufacturing plan describing all conventional and numerically controlled machining operations and instructions; a numerical-control drawing of the part, showing the path of the cutter, and the sequence of cuts; a numerical-control process sheet containing machining data in numerical-control code; and paper process tape prepared with Flexowriter typing of the data.

The original process tape is retyped for verification, the data are fed through the computer, and the machine-control tape is punched.

All tape preparation is accomplished in an air-conditioned, humidity-controlled room located in the manufacturing engineering office. Only the machine-control tape, the write-up, and part drawing are forwarded to the shop. All other data are filed for future use.

A week-long series of acceptance tests on the punched-tape-controlled profile-milling machine was devised by Martin engineers to determine the accuracy, repeatability, and dependability of the complete system.

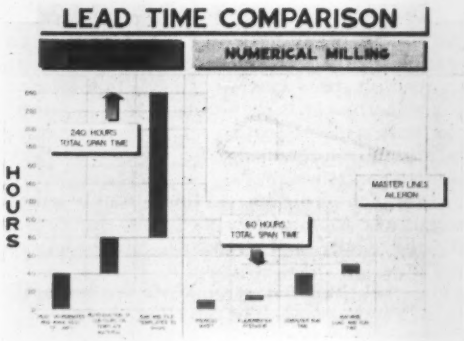
While the accuracy obtained was not quite up to the 0.001 and 0.002-in. tolerances expected, a ±0.005-in. tolerance was being achieved by new operators.

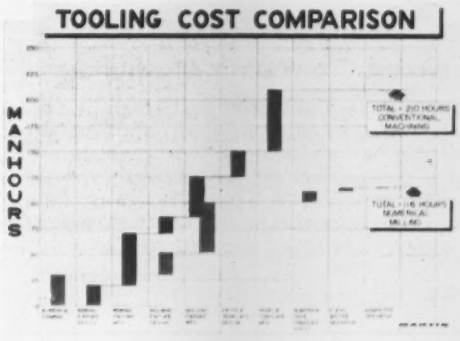
The feed rate was too fast in relation to cutter diameter, causing deflection of the cutter.

A cutter and holding fixture of sufficient rigidity should lower the 0.005 run-out and possibly obtain the tolerance originally expected.

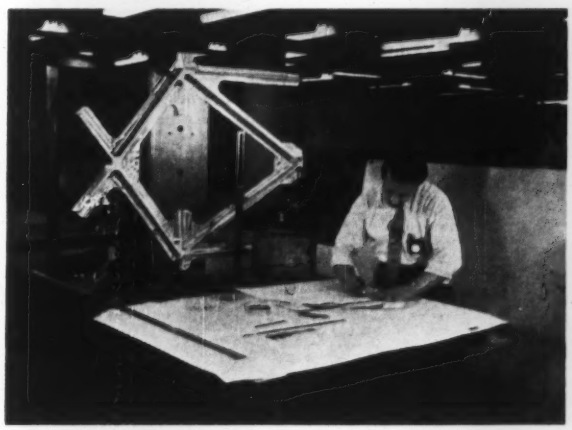
The machine is expected to run maintenance-free 85 to 90 per cent of its planned operating time.

Some reduction in down-time is expected with experience and quicker detection and correction of routine troubles. Each day 30 to 60 min are spent on preventive maintenance which brings all phases of the machine-





Inspection of a machined part and acceptance of the tape by the quality-control department



The numerically controlled milling machine can mill one part in 2 hr instead of the 8 hr needed with conventional methods

control unit into operation and determines if any electronic components have failed or are about to fail.

A periodic check is also made of the alignment of the milling machine which will be continued once a month until the settling of the machine foundation ceases.

After acceptance tests, production machining was started on a limited basis.

In machining the first part, 50 per cent of the time was spent changing and adding clamps to the holding fixture while the machine stood idle. Much of this lost machining time could have been avoided if the heavier cuts and faster feeds possible with numerical control had been considered.

To avoid making a completely new tape each time an error was discovered, the job was broken into operations having about 4 ft of leader between them. In this way, an incorrect operation could be cut out and the corrected one inserted.

As bad parts in the tape were replaced, the speed and feeds on the corrected tape were increased for roughing cuts where a heavier cutter could be used and accuracy was secondary, resulting in speeds and feeds 100 per cent greater than originally planned.

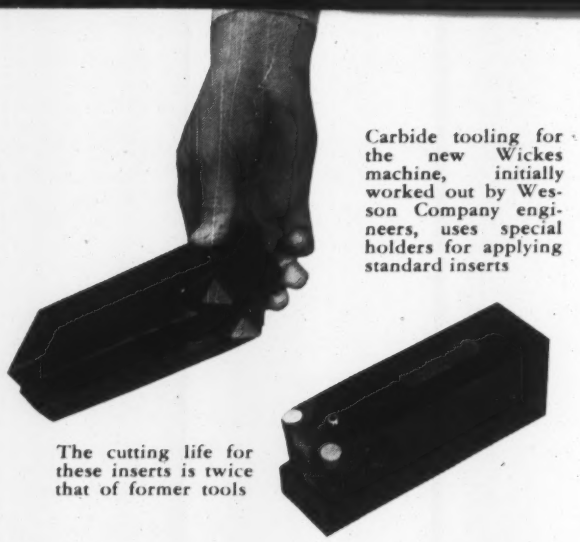
In spite of all the mistakes on this first tape, the rough machining time has been reduced to a fourth of that formerly required by conventional methods.

Much has been learned about the limitations and the potentialities of this new system. The potentialities seem limitless.

Automated Crankshaft Machining

MACHINING an automotive crankshaft is one of the toughest metal-cutting jobs in the metalworking industry because of the ease with which a shaft is deflected, the hardness of the material, and the many bends. Machine tools designed 30 years ago for machining forged-steel crankshafts two at a time were standard until recently. Principal progress had been in the substitution of more easily machinable materials—cast iron, shell-molded nodular iron, and modified cast steel.

The Wickes Corporation's Machine Tool Division in Saginaw, Mich., has spent eight years of research in developing a new concept for machining crankpin diameters of forged-steel crankshafts which doubles production in approximately the same floor space, allows carbide cutting tools to be used, almost eliminates retooling costs, reduces manpower, cuts tool costs in half, reduces capital investment, and permits machining crankshafts of several diameters on a single line.



Carbide tooling for the new Wickes machine, initially worked out by Wesson Company engineers, uses special holders for applying standard inserts

The cutting life for these inserts is twice that of former tools

Under the automated concept, a series of single-purpose lathes is spliced together in a line. Each of these is fed by a common automated line parallel with the in-line lathes for progressively machining the Nos. 1, 2, 3, and 4 pin diameters of a forged-steel 4-throw crankshaft of a typical V-8 automotive engine.

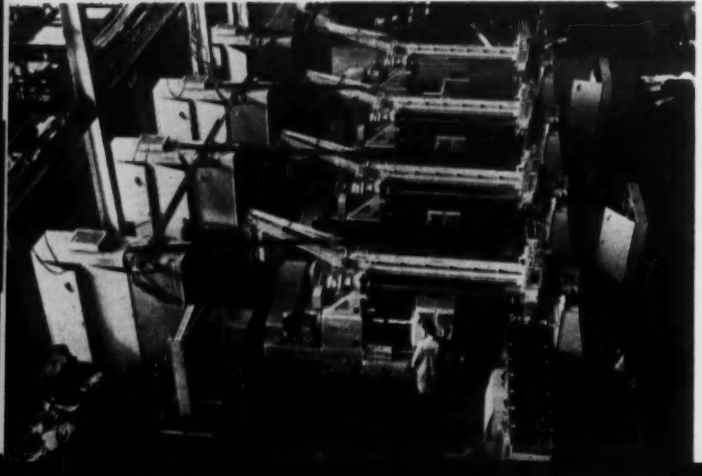
Provision is made for 5-min tool changes per lathe, the use of standard-insert carbide cutting tools, the machining of only one crank pin at each station, and continued production of other machines while one is down for tool changes.

Machine speeds are stepped up from 60 fpm to over 250 fpm. This means the use of cemented carbide cutting tools for the first time—not in the low, but in the medium-to-high-speed cutting range. It also means an hourly production of each 4-station in-line setup of 50 crankshafts per hr. Formerly, 12 lathes were required for machining pin diameters to obtain a crankshaft output of 150 units per hr.

Retooling such an automated line is simply a matter of changing tools to meet specifications, since chucking remains the same, and standard carbide inserts are involved.

When a crankshaft arrives opposite the first spindle of the No. 1 lathe, a cross-slide traveling at right angles to the automated conveyer picks up the shaft, reverses, and carries the work about 5 ft, placing it in the open chucks of the machine. The lathe automatically clamps the work, and brings the cutting tools into action. Less than a minute later, the No. 1 pin of the shaft is completed and a second overhead slide carries the work back to the automatic in-line transfer device. Similar operations take place at succeeding lathe stations.

The 4-station automatic transfer machine is equipped with an automatic loading line, *right*, and control panels for the horsepower at the *left*



The loading device for the automated crankshaft system transfers a crankshaft to the No. 1 station. Cross slides carry the work to and from the machine.

Variable Moderator Control

CONTROL and shim would be effected in an improved type of boiling-light-water reactor by varying the level of the moderator which surrounds the fuel-containing coolant channels. Combined with fossil-fuel-fired superheat, the system could incorporate to a maximum extent existing steam-plant technology for nuclear power plants ranging in generating capacity from less than 20 to more than 200 electrical megawatts. Where fossil-fuel dependence would be undesirable, saturated-steam turbines could be used.

The system proposed by the Atomic Energy Division of American-Standard was described in a paper presented at the 1957 Winter Meeting of the American Nuclear Society, New York, N. Y., by John Cobb.

Condensate passes from the condenser hot well through several feedwater heaters and into a variable-speed feed pump. This pump, in combination with a control valve, regulates the moderator level by varying the rate of feedwater return to the reactor, where it is injected into the moderator region surrounding the fuel elements.

This water flows down around the fuel elements until it is drawn off at the moderator outlet, mixed with recirculating coolant, and injected into the lower plenum of the reactor vessel. Now serving primarily as coolant, the water is pumped through the inside of the fuel elements, around the fuel pins, where it boils. A mixture of water and steam is ejected from the tops of the fuel elements, the steam leaves the reactor vessel through the main steam line where it enters a steam separator, while the water is recirculated. From the separator, the steam passes through a gas or oil-fired superheater and then to the turbine.

Feedwater make-up is provided through a demineralizer system. Scram is accomplished by opening a fast-acting valve in the dump line which allows a limited portion of the moderator to flush into a dump tank.

Internal cooling of the fuel elements can be maintained during shutdown or following a scram by continuing to recirculate the coolant from the moderator and overflow areas through the fuel elements.

According to the author, reactor stability and control for a system in which the coolant-moderator boils, in which the noncoolant moderator does not boil, and in which control is effected by varying the active core height, is a problem that will require a considerable amount of detailed analysis and experimentation to resolve. A preliminary analytical examination has been completed, and analog simulation is planned.

Powder-Lancing

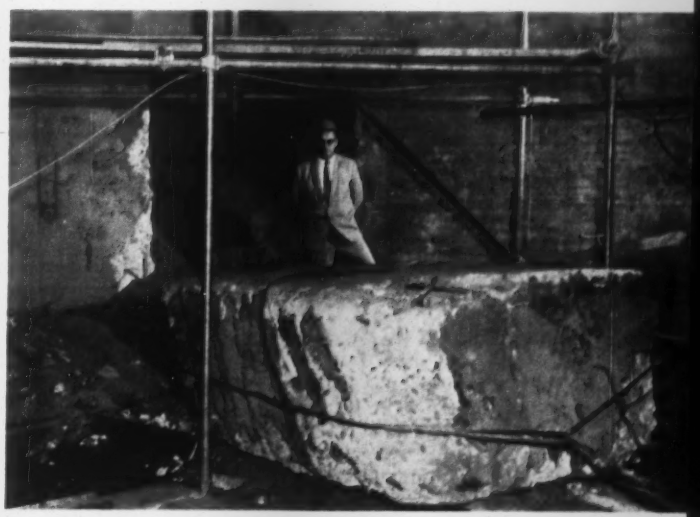
A PROCESS known as powder-lancing is being used to remove over 8000 cu ft of concrete up to 4 ft thick in demolition work at the General Electric Company's General Engineering Laboratory, Schenectady, N. Y. The building is being converted into a million-dollar radiation laboratory scheduled for completion in 1958.

The technique is an outgrowth of the powder-cutting process first introduced in 1943, by Linde Company, Division of Union Carbide Corporation, as a method of cutting stainless steel. Today, powder-lancing is widely used in the steel industry for producing shot holes in open-hearth furnace slag pockets. With recent development in apparatus and new operating techniques, it is now practical to cut thick concrete—especially where mechanized demolition methods are too costly, where time is an important factor, and where blasting cannot be employed.

A mixture of iron and aluminum powder is fed pneumatically into a lance handle and mixed with oxygen. The lance itself is manually operated and consists of a lance handle with one or more lengths of black iron pipe attached. The powder and oxygen are mixed in the lance handle, carried to the cut by the pipe, and produce a bombardment of burning iron and aluminum particles which melts the concrete. Cuts in concrete 12 ft thick have been made with the lance, but theoretically, there is no limit to the depth of the powder lance's cut.

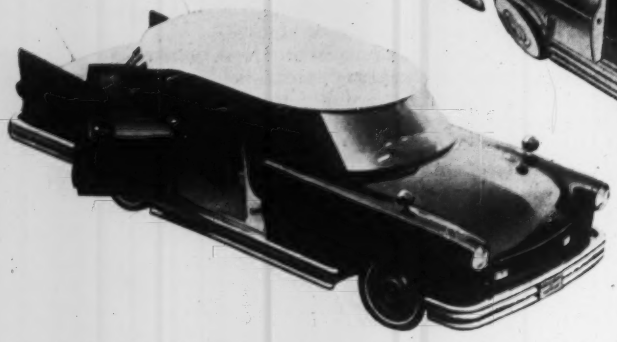
The concrete walls at General Electric are being cut into huge sections measuring 20 × 16 ft and weighing up to 18 tons apiece. Cutting speed is about $1^1/_2$ ft per hr. After each of the sections has been severed, it is hoisted out of the pit by a 100-ton bridge crane and hauled away.

This unusual demolition project, which is being handled by James E. Lowe and Sons, of Schenectady, N. Y., will take from 4 to 6 weeks to complete, with savings of 30 to 40 per cent expected.

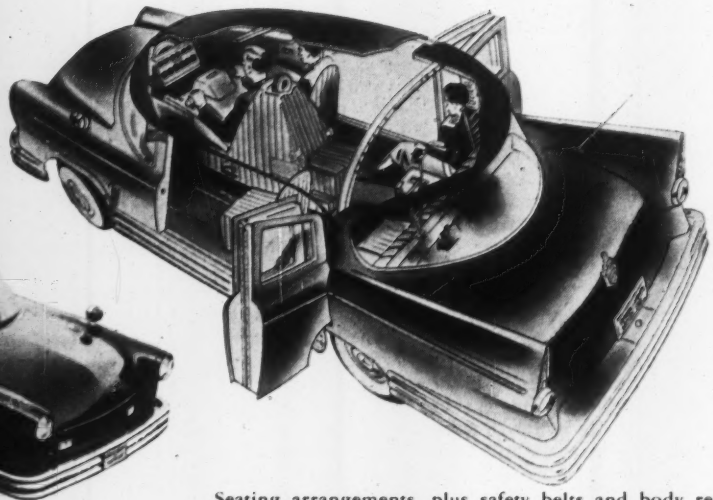


A massive concrete section cut away with the powder-lancing technique formerly used for stainless steel and now adapted for concrete demolition work. Walls are cut into large sections moved by crane.

Both safety and good design are served by the elimination of nonfunctional exterior ornaments from the Cornell-Liberty Safety Car. The only external objects are two rear-view mirrors on the fenders, which are



hemispherically shaped to reduce their injury potential to pedestrians. The extra-wide side and wrap-around bumpers are designed to provide unexcelled protection from crash impacts, as well as helping to convert direct blows into glancing ones.



Seating arrangements, plus safety belts and body restraining devices, make it impossible for passengers of the Cornell-Liberty Safety Car to be injured by striking anything in the interior of the car. The potentially lethal steering wheel and steering column have been replaced by a lever system. A centrally located driver's seat, plus a constant radius windshield, provide undistorted vision for the driver and give him maximum protection.

Safe Automobile

AN AUTOMOBILE has been designed and built with the safety of the occupants as the sole design objective.

The new car represents the culmination of a five-year research program sponsored by the Liberty Mutual Insurance Company of Boston, Mass., and carried out by the Safety Design Research Department of the Cornell Laboratory, at Buffalo, N. Y.

The research program showed conclusively that most automobile accident injuries were caused when the occupants were thrown against the windshield, steering wheel, dash, or other fixed objects inside the car. To eliminate or reduce the severity of such accidents, Liberty and Cornell developed the concept of "packaging" the passenger in much the same way that fragile merchandise is packed to prevent damage in shipment.

This concept has been carried out in the construction of the car by strengthening the body; designing the doors so that crash forces cannot open them; securing the passengers inside the car with seat belts or other devices; and eliminating or redesigning objects or controls such as the potentially lethal steering wheel.

The car also provides the driver with better visibility and more positive and simple controls, and has a new type of ventilating system which virtually eliminates carbon-monoxide fumes inside the car.

Most radical innovation has been the elimination of the steering wheel in favor of a lever-controlled hydraulic system, and the relocation of the driver's seat in the center of the car.

All seats are of the bucket type, which provide more lateral restraint than conventional seats, and reduce riding fatigue. A rear-facing seat, built onto the back of the driver's seat, faces individual rear seats located somewhat farther back than usual, providing six individual seats in all.

With this arrangement, each passenger is prevented from striking any part of the vehicle or himself in an accident.

Rear seat passengers are protected by seat belts which reel up when released, and are protected against "whiplash" injuries by nylon harnesses to support the head.

Front seat passengers, including the driver, are restrained in their seats by U-shaped webbing yokes which are supported on movable and adjustable panels. A pull-up headrest protects the driver against whiplash injuries. A soft pad in front of the driver's chest gives additional protection against chest injuries.

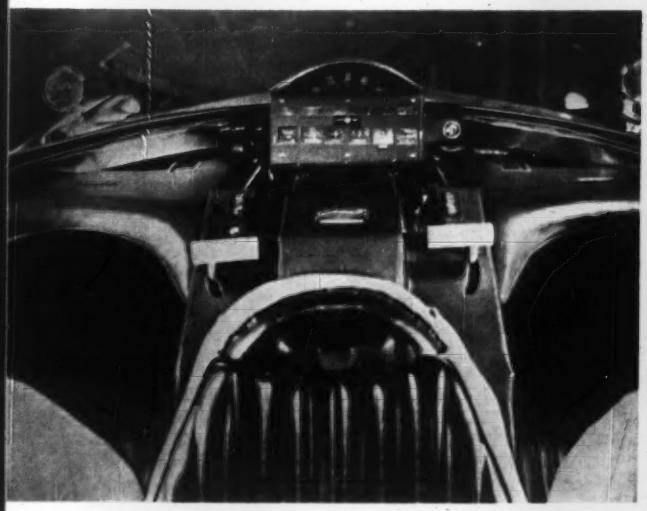
To steer the car, the driver grasps two horizontal control handles and moves them as though steering a sled. All other controls are within easy reach.

The steering handles move only 6 in. in turning the car from full right to full left. The steering ratio varies, depending on the position of the wheels. When they are dead ahead, the ratio is 15 to 1, varying to progressively lower ratios until the ratio is 0.8 to 1 when the wheels are turned to the extreme limit, providing average steering sensitivity under normal driving conditions, and maximum sensitivity in emergency.

The speedometer is placed forward, with the other six driving instruments located in a horizontal cluster just below. Each instrument has a corresponding signal light above it that turns red if something is wrong, preventing unnecessary diversion of the driver's attention from the road.

The windshield is shaped to a constant radius of curvature, and does not distort the view on either side. It allows approximately 180 deg of vision for the driver.

A ventilating intake scoop, located above the windshield under the roof projection, collects air at a level where there is a minimum of carbon monoxide, and causes a slight positive pressure inside the car to prevent the infiltration of fumes.



Interior of the Cornell-Liberty Safety Car from a position just back of the centrally positioned driver. The handles of the lever-type steering system are shown. Gear shift buttons are placed just in front of the steering controls. Instrument panel and speedometer are located well below line-of-sight.

The driver of the Cornell-Liberty Safety Car steers the car by pushing or pulling the two handles in much the same manner as in steering a sled. Inlets for a pressurized ventilating system which forces air around the curved surface of the windshield are at the *left*.

The doors consist of two sections, hinged at the center and to the body post opening and closing like telephone booth or bus doors with the lower edge supported by rollers moving in a track. They are securely closed by three bolt bars designed to keep the doors closed in a collision, thus maintaining full structural support of the car body. Two roll-over bars have been built into the top of the car body to give added support.

Front and rear bumpers are designed so that they wrap around the sides of the car as far as the wheel openings in the fenders. Energy-absorbing cellular-plastic material between bumpers and back-up plates absorbs some of the initial shock energy. In addition, the bumpers are smoothly shaped so that they convert an increased proportion of blows from direct to glancing ones. The side bumpers are rigidly mounted.

Sports Cars

HEAVY TAXATION and very high insurance premiums may have crippled the British sports-car market, but according to an editorial in *Engineering* for Oct. 11, 1957, sports cars account for an increasing proportion of British vehicle exports. The four international motor shows this autumn—in Frankfurt, Paris, London, and Turin—show that this class of vehicle is in a state of intensive development.

Britain opened up the market, particularly on the West Coast of the United States, with a range of cheap reliable sports cars made largely from standard components already in production for touring models, and these still sell in significant numbers.

Although theoretically a sports car should be able to compete in sporting events with some hope of success, simple low-cost cars are no longer able to compete with special racing machines.

American manufacturers, impressed by the success of imported sports cars on their own doorstep, have entered the market, but with cars of sporting appearance designed to appeal to those who like to go to motor races but do not intend to compete. The Chevrolet Corvette, the Ford Thunderbird, the Studebaker Hawk range, including one supercharged model, and now the Packard Hawks, are all cars of sporting type with a large measure of comfort and luggage space, equipped with heaters, radio, and automatic transmissions if desired. In some cases the range-selector level for the automatic transmission takes the form of a central gear leaver, to add to the illusion.

It seems likely that this market will eventually be much larger than that for the pure sports car, and European manufacturers are energetically catering for it, with very well finished coupes and convertibles, using stock engines suitably modified for higher power output. But quite apart from bodywork, it is noteworthy that all these Continental models have independent rear suspensions, or a rear axle located by some means more precise than the master leaf of a half-elliptic spring.

British engines and brakes are good and inexpensive, the article notes, but it is time British engineers give more attention to the design of their chassis. Even the Jaguar, which is virtually invincible on the billiard-table surface of Le Mans, is quite unable to keep up with smaller-engined cars on the Nurburgring, or even on a tricky circuit like Aintree, at home.

In the smaller classes, British designers have produced competition machines which are at present unbeatable, but as yet, their success is not reflected in the design of the commercial models in large-scale production. So far, the low-priced sports car has proved a lucrative by-product of touring car production for some of the big manufacturers, but this phase may be drawing to an end.

The editorial concludes that manufacturers may yet find it a better long-term investment to use their sports cars as a means of initiating chassis improvements which will benefit future touring cars.

Engineering Research Leads

THE National Science Foundation has issued a report on "Basic Research, A National Resource," which is a study of completed surveys for the academic year 1953–54 of research in the "physical and life sciences."

Questionnaires were sent to 15,000 private industrial firms, commercial laboratories, colleges and universities, philanthropic foundations, and other research organizations. The surveys also covered the scientific activities of the Federal Government.

The groups questioned employed an estimated total of 900,000 scientists and engineers, one third of whom were actually employed in research and development. These institutions spent an estimated $5.4 billion on the support and conduct of research and development in the physical and life sciences, or about 1.5 per cent of the gross national product for that period. Basic research funds were reported in the amount of $435 million—8 per cent of total research and development expenditures, or one eighth of 1 per cent of the gross national product.

Largely because of the national defense effort, the Federal Government was the principal source of funds, spending more than half the $5.4 billion total. The industrial group provided a little over two fifths.

According to the report, the contributions of educational institutions and of other nonprofit groups were surprisingly small, since relatively little income for research was available to them from State appropriations, endowment returns, or other sources.

The industrial group was by far the leading performer, spending three quarters of the estimated total funds available, and financing about 60 per cent of the work with its own funds. The rest came from the Federal Government.

Educational institutions and other nonprofit organizations together performed only 10 per cent of all research and development in the natural sciences. These groups, however, performed half of the nation's basic research.

Engineering received more funds than any other type of research for all groups. Seventy-four per cent of the Federal Government's contribution went to the physical sciences, mostly to engineering and physics. Engineering and chemistry obtained more than half of industry's contribution, which incidentally accounted for only 10 per cent of the total expenditures in each of these fields.

Engineering also led in university expenditures for research, accounting for 17 per cent of the funds or $28 million of a total of $157 million.

The report contains some comments on translation by electronics and its significance for basic research in particular, where exchange of information is so important.

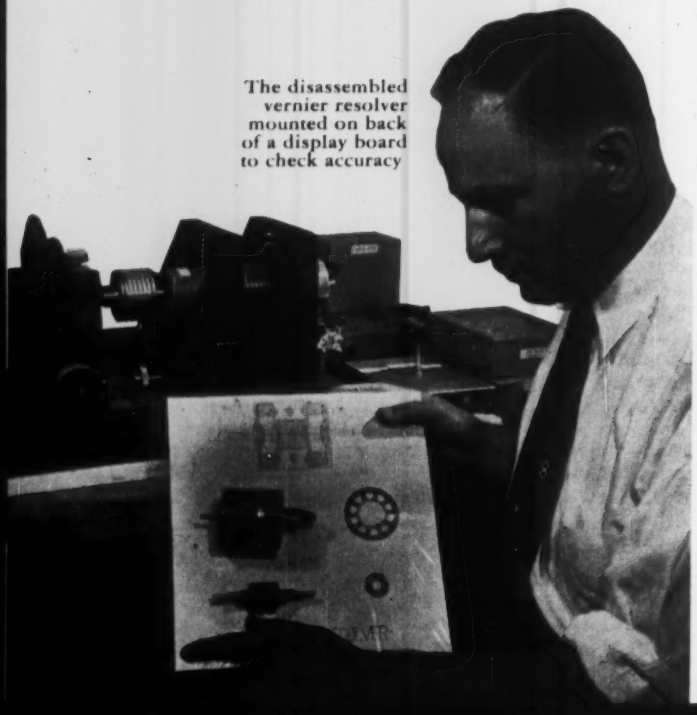
Initial translations by machines with a limited vocabulary have demonstrated the feasibility of the method.

Extremely compact magnetic devices, themselves the outcome of basic research in magnetism, and the physics of crystal structure, have been designed for storing information. They make it possible to build memory units which hold larger vocabularies in a smaller space.

Machines to be developed during the coming years will not turn out highly polished literary works. On the other hand, the translations will be good enough so that they can be followed readily by specialists. Automatic translators are likely to be used on an increasing scale in efforts to overcome international language barriers in science.

Recently, several American industrial laboratories spent 5 years and at least $200,000 conducting studies of the design of electrical circuits only to find afterward that the work had already been done and was published in another language.

The report which acknowledged the difficulty of distinguishing between basic and applied research and of classifying types of research, represents the most comprehensive survey yet made. The complete report is available for 45 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.



The disassembled vernier resolver mounted on back of a display board to check accuracy

High-Precision Vernier Resolver

AN ELECTROMAGNETIC angle transducer of exceptionally high precision, called the vernier resolver, has been developed by Bell Telephone Laboratories under an Air Force contract. The resolution of this transducer is better than ±3 sec of arc.

Such a resolver has potentially wide applications for visual and automatic angle reading systems. At Bell, it has been used in an "angle encoder" which converts a shaft angle to a numerical representation acceptable to a digital computer. The standard deviation of the error of this complete encoder is less than 10 sec of arc.

The vernier resolver is a reluctance-type, variable-coupling transformer. In the present design, two output voltages are produced which vary in amplitude as the sine and cosine of 27 times the angle through which the rotor is turned. Thus the equivalent of a standard resolver driven by a 27 to 1 gear train is obtained. Other ratios are possible.

The unit is of small size and simple construction. All windings are on the stator, leaving the rotor free of sliding contacts.

Models of this resolver are being built by Clifton Precision Products Company, Clifton Heights, Pa.

Bad Technical Writing

EXAMINATION of scientific and technical reports, technical correspondence, and signed technical articles in scientific and trade journals reveals a harvest of bad writing.

Thus writes John L. Kent, President of the Technical Writing Improvement Society, Pasadena, Calif., which has set itself "to make science and industry understandable." He continues:

Examination of some articles shows that the authors did not plan their writing, probably made no outline, and apparently failed to edit their work. They have imposed on the reader, wasted his time. The reader feels cheated.

Certainly, engineers are not expected to be Hemingways. But unless an engineer puts over his knowledge and experience in writing—well enough to be understood by other engineers—he is doing an injustice to his career and to the organization that employs him.

To Write or Not to Write

Should a substitute technical writer be called in? Or should the engineer produce his own account of his accomplishments and findings? It is felt that the engineer should be his own writer. But he must be sufficiently skilled to present the information effectively. How shall he acquire this skill?

Courses are few, and the textbooks are long on theory and short on practical help. Many firms have written their own writing instruction manuals. Others are acquiring reprints of the few good articles that are printed in the technical journals.

Other firms are sending their people to short writing courses such as those given by the Western Technical Writing Institute, in San Marino, Calif., or to special "beefing up" courses such as those held annually by the Technical Writers Institute of the Rensselaer Polytechnic Institute, Troy, N. Y.

My own organization—Technical Writing Improvement Society—has been formed by trade journal editors, educators, and industrial technical publications chiefs, specifically to help technically trained people write better. Under the society's education program, article reprints are being made available, and other improvement aids are planned.

A textbook is very much needed. It should include some of the tricks of the trade of the professional writer, tricks which can be adopted by the engineer. Additionally, it should include instruction and examples of the basic patterns of technical and management reports. These are fairly well standardized, but engineers still use the old "laboratory" style for all reports. The book should also include examples of modern technical article writing and the writing of technical sales literature and instruction sheets and manuals.

The Ultimate Remedy

Temporary remedies aside, the problem must be attacked in the schools. Management should impress upon the deans of engineering schools that it wants graduates who can express themselves in writing. It must be clear that science and industry want people who can make themselves understood in writing, and thus do justice to themselves and their organizations.

Reactor Control by Spectral Shift

BY DILUTING D_2O with H_2O in pressurized-water-moderated reactors, more efficient control should be obtainable than with the present method of withdrawing neutron-absorbing control rods.

The method proposed by the Atomic Energy Division of The Babcock & Wilcox Company and outlined by M. C. Edlund and G. K. Rhode, gradually dilutes the heavy-water moderator with light water to compensate for the loss in reactivity as fuel is partially consumed and fission products accumulate.

The change in the composition of the moderator causes a shift in the neutron spectrum. Neutrons previously captured by the breeding material in the resonance range are freed to cause fissions in the fuel. The method would allow much higher burnup without lowering the conversion ratio, and give a more uniform power distribution in the core.

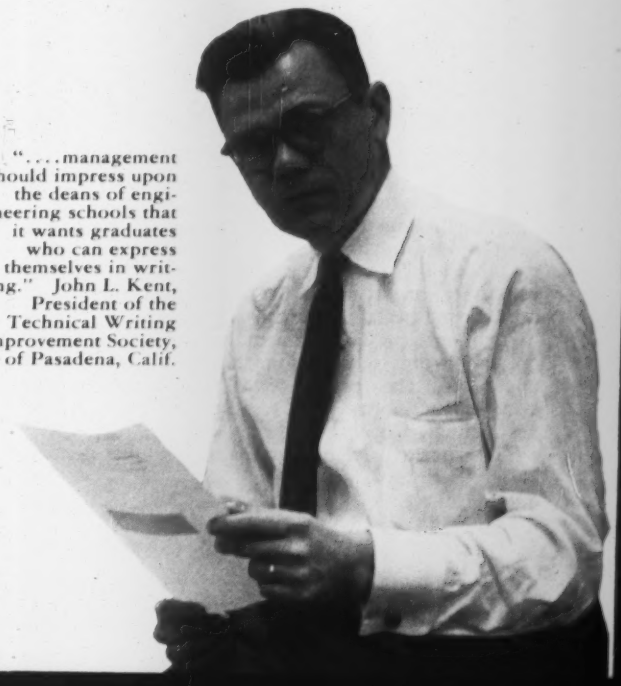
At start-up, the moderator is about 85 per cent D_2O and 15 per cent H_2O. The positive reactivity of the excess fuel, with which it is necessary to load the reactor to compensate for the anticipated drop in reactivity as fuel is consumed, is partially offset by resonance capture in the fertile material.

As the excess reactivity decreases from fuel burnup and fission-product formation the heavy water is diluted still further. Since light water is a more efficient moderator, the neutrons are slowed down to thermal energies more quickly, and have less opportunity to be captured in the resonance region. Exact shim control might be obtained at all points during the lifetime of the core, with excellent neutron economy.

The method provides more uniform power density, which means that more power could be extracted from a given-size core. This economy would be partially offset by the necessity for purifying the heavy water diluted during the reactor run.

However, the cost of a distillation plant for the reconstitution of heavy water is relatively inexpensive (about $1.5 million to build, and $150,000 per yr to operate, for a hypothetical 500,000-kw power plant). This is compared to the fact that excess fuel equivalent to as much as 50 per cent excess reactivity could be accommodated by the spectral-shift system.

The method was described in an article in *Nucleonics*.



"....management should impress upon the deans of engineering schools that it wants graduates who can express themselves in writing." John L. Kent, President of the Technical Writing Improvement Society, of Pasadena, Calif.

Nuclear Briefs

▶ "Parity Conservation" Not Applicable to Neutron Decay

Scientists at the University of Chicago and Argonne National Laboratory have proved, with the aid of an Argonne nuclear reactor, that the law of "parity conservation" does not apply in the radioactive decay of the neutron. The research was supported by the AEC. Earlier this year parity was demonstrated not to hold for complex nuclei or mesons by physicists Tsung Dao Lee and Chen Ning Yang, who are to receive the Nobel Prize for their findings, on December 10.

Since these widely heralded experiments, many physicists have shown great interest in learning the results of such measurements of neutrons—particles with no electric charge but with a mass approximately the same as that of the proton. These scientists believed that a test of the parity law properties in the case of the neutron would provide a particularly clear-cut measurement for current or proposed theories concerning the basic properties of matter.

If the principle of parity were correct, the electrons produced by the decay of the neutron should be emitted equally toward both poles.

Instead, the results of the Argonne-University of Chicago investigation proved that only about 62 per cent as many electrons came off in the direction of the south pole as in the direction of the north pole.

▶ Neutrons Produced From Thermonuclear Reactions?

Reports from the U. S.-U. K. meeting at Princeton on the temperatures reached in the controlled thermonuclear experiments in the two countries suggest the achievement of neutrons from thermonuclear reactions, but more experimental work will be necessary for confirmation.

According to the AEC, the realization of the production of thermonuclear neutrons, if definitely established, would be only a step, although an important one, in the long-range effort to develop thermonuclear reactors for the production of commercially practical electric power.

▶ Another Pressurized-Water Reactor Submarine

The fifth reactor plant to be designed and developed by Westinghouse for submarine use under contract with the AEC and U. S. Navy, will power the USS *Sargo*, third of the Navy's fleet-type nuclear-powered submarines to be launched this year.

The reactor for the *Sargo* is of the pressurized-water type, similar in principle to that of the *Nautilus* but incorporating new concepts and advances in reactor design. These will permit construction of a smaller craft to satisfy special service requirements.

▶ APPR's First Six Months

The first six months of operation of the Army Package Power Reactor have shown that the basic design concept is "very practical not only as intended but also for submarine applications," according to one of the papers presented in the session devoted to the APPR at the meeting of the American Nuclear Society, New York, N. Y., Oct. 28–31, 1957.

Representatives of Alco and Stone & Webster, who designed, built, and operated the APPR for the Army, indicated that the simplified control system which is adjusted entirely by hand except for scramming, and the other simplified features intended for remote operation by relatively inexperienced personnel have proved satisfactory in operation. Subassemblies, used wherever possible, are simply replaced by new ones in case of failure. Simplified fuel handling requires no power equipment.

The APPR pressurized-water system shows excellent response to load requirements, with no detectable boiling. The reactor steps up to full load in 70 sec, the maximum permitted by the turbine manufacturer. Some excess reactivity over that calculated for the core is attributed to conservatism and unknowns.

Materials Briefs

▶ Synthetic Diamonds Ready for Production

The Metallurgical Products Department of the General Electric Company is planning to produce synthetic industrial diamonds in substantial quantities. More than 100,000 carats have already been produced in pilot-plant operations at Detroit, Mich.

The gap from research to pilot-plant production has been bridged in slightly more than two years, compared to a normal 5 to 10 years. Production should replace imports of an estimated 7 million carats of fragmented bort for industrial use within a few years.

Although the Government has placed secrecy orders on the patent applications covering the process and apparatus, the project was accomplished without government money, and represents a $\$2^1/_2$ million investment by General Electric.

The current price of man-made ungraded diamonds is slightly above the cost of ungraded natural diamonds but should come down with improved techniques.

The synthetics are large enough for most present industrial abrasive requirements. The larger ones are about the size of a grain of coarse sand and smaller than a grain of fine white sand. Collectively, they look black or gray but individually they have many variations of color.

▶ Attaching Sandwich Components

Lightweight sandwich construction—which is being utilized increasingly in the fabrication of aircraft and missile components—poses a continuing problem for the aircraft designer: how to attach these core-and-faces structures to the supporting airframe.

Conventional mechanical fasteners are seldom practical for attaching sandwich components because they tend to crush the internal core which has comparatively little compression strength in highly localized areas.

In designing sandwich-type access doors for the Air Force's huge C-133A turboprop cargo-transport, engineers at the Long Beach, Calif., division of Douglas Aircraft Company have developed a highly successful solution to the sandwich attachment problem. Eight access doors located on twin landing gear pods of the C-133A are fabricated of multiple layers of honeycomb aluminum core faced with reinforced fiberglass skins. To attach metal hinges and the locking mechanism to each of the lightweight doors required 40 through-sandwich attachments and 20 blind attachments.

Douglas engineers employed a room-temperature-setting putty, Narmco Formula Putty 3119, manufactured by Narmco Resins & Coatings Company, to provide localized bearing strength within the core material for these through-sandwich and blind attachments. This putty is an epoxy-type resin with inert fillers added to the proper consistency for casting, edging, caulking, and similar applications.

To attach the hinges, twenty $^1/_2$-in. holes were drilled through one skin and the core; then the surrounding core was filled with putty to the first vertical-cell column. Afterward, $^1/_4$-in. holes were drilled through the putty plugs, and metal bolts were inserted and fastened with nuts to secure the hinges.

Blind attachments for the locking mechanism were made by forming similar putty core plugs within the core and fitting steel bolts through the internal skin into aluminum fasteners anchored in the putty plugs.

These putty-secured attachments, which are utilized in every sandwich access door on the C-133A, have proved highly satisfactory, according to Douglas engineers. In shear tests of the completed structure, for example, both the skins and the honeycomb core failed before the putty-supported attachments.

▶ Carbide-Coated Graphite

A hard, refractory, smooth, and wear-resistant coating is placed on machined graphite parts with a method developed by Horizons Incorporated, Cleveland, Ohio, a process and material-research organization. A carbide coating is integrally bonded to the graphite, and its smoothness is a function of the smoothness with which the base graphite can be prepared. Coatings are complete, even in undercuts, holes, drilled areas, milled sections, and the like. Thicknesses can be varied between 40 and 250 microns. Above this limit, the material tends to exfoliate.

In the specified thickness, the coating shows excellent heat shock resistance and integrity under cyclic conditions. Melting point is 2000 C or higher, with a hardness of 2000 Vickers minimum. In reducing and vacuum atmospheres, the coating is chemically stable.

The material shows a fair degree of oxidation resistance, superior to graphite; and additional work on the coating may increase oxidation resistance substantially.

Several potential uses are for coated cores in liquid-fueled nuclear reactors to prevent absorption of uranium-bismuth or thorium-bismuth slurries by the graphite; to prevent erosion and corrosion of graphite fixtures used to hold honeycomb parts during brazing or soldering; to prevent chemical attack or absorption by the containers used for continuous evaporation of metals; and for the replacement of hard-to-machine silicon-carbide inserts used in the die casting of aluminum and copper alloys.

▶ Aluminum Investment Casting

For the first time, tensile strength, yield strength, and elongation properties actually present in an aluminum investment casting can be guaranteed, and are far higher than those known as aircraft quality.

Arwood Precision Casting Corporation of New York, N. Y., has achieved the improved castings by developing entirely new techniques.

A comparison with aircraft-quality castings shows that not only does the new Arwood "Suparcast" process improve properties throughout the entire casting, but still greater improvements can be added in critical or high-stress areas.

Aeronautical Material Specification 4260 calls for 24,750 psi, tensile strength; 16,500 psi, yield strength; and 7 per cent elongation in specimens cut from the casting.

Arwood can guarantee the following properties in all areas of the casting: 34,000 psi, tensile strength; 25,000 psi, yield strength; and 3 per cent elongation.

In areas designated as critical, Arwood can raise these guaranteed properties to 38,000 psi, tensile strength; 27,000 psi, yield strength; and 5 per cent, elongation.

With guaranteed mechanical properties like these, parts can be cast which previously could be formed satisfactorily only by forging or machining. Not only can castings be designed to higher limits, but increased strength and decreased weight are indicated. In addition, lower porosity means improved pressure tightness.

▶ Aluminum Soldering

Simple and effective techniques for soldering aluminum and its alloys as well as galvanized metals have been developed by G. M. Bouton and P. R. White, metallurgists at Bell Telephone Laboratories. These techniques employ an inexpensive and stable zinc-base alloy as a preferred solder, and no flux or vigorous abrasion is necessary. Joints in aluminum made by these methods are stronger than commercial aluminum itself. They are most effective for those types of joints where the surfaces are accessible for manipulation with the solder stick, such as butt and "T" joints.

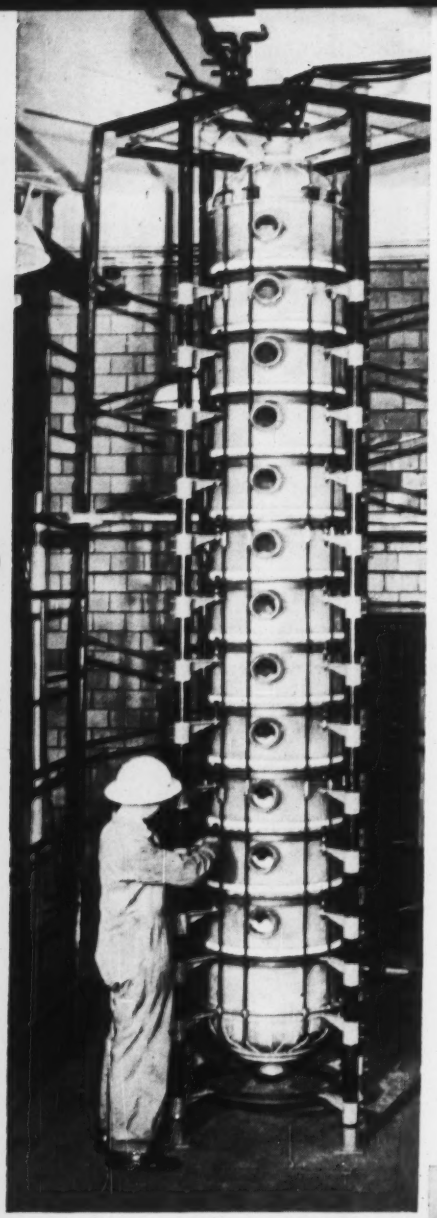
Long term stability of the soldered joint is assured by the rigid exclusion from the high-purity zinc-base alloy of deleterious elements such as lead, tin, bismuth, and cadmium to prevent intergranular corrosion. A fraction of a per cent of magnesium may be added to enhance its stability, and up to several per cent of aluminum may be included.

In soldering aluminum it is not necessary to remove rolling-mill oils or the surface oxide from the area to be wetted. A single stroke of the solder stick across the heated aluminum surface will cause the solder to penetrate the oxide and wet the aluminum. The normally tenacious oxide film is lifted off much like paint peeling from wet wood. This raised oxide coating may then be wiped aside.

Surfaces thus wet can be joined by bringing them together and adding more solder by drawing the solder stick across the hot metal pieces. Heat may be applied electrically or by means of torches burning common fuels.

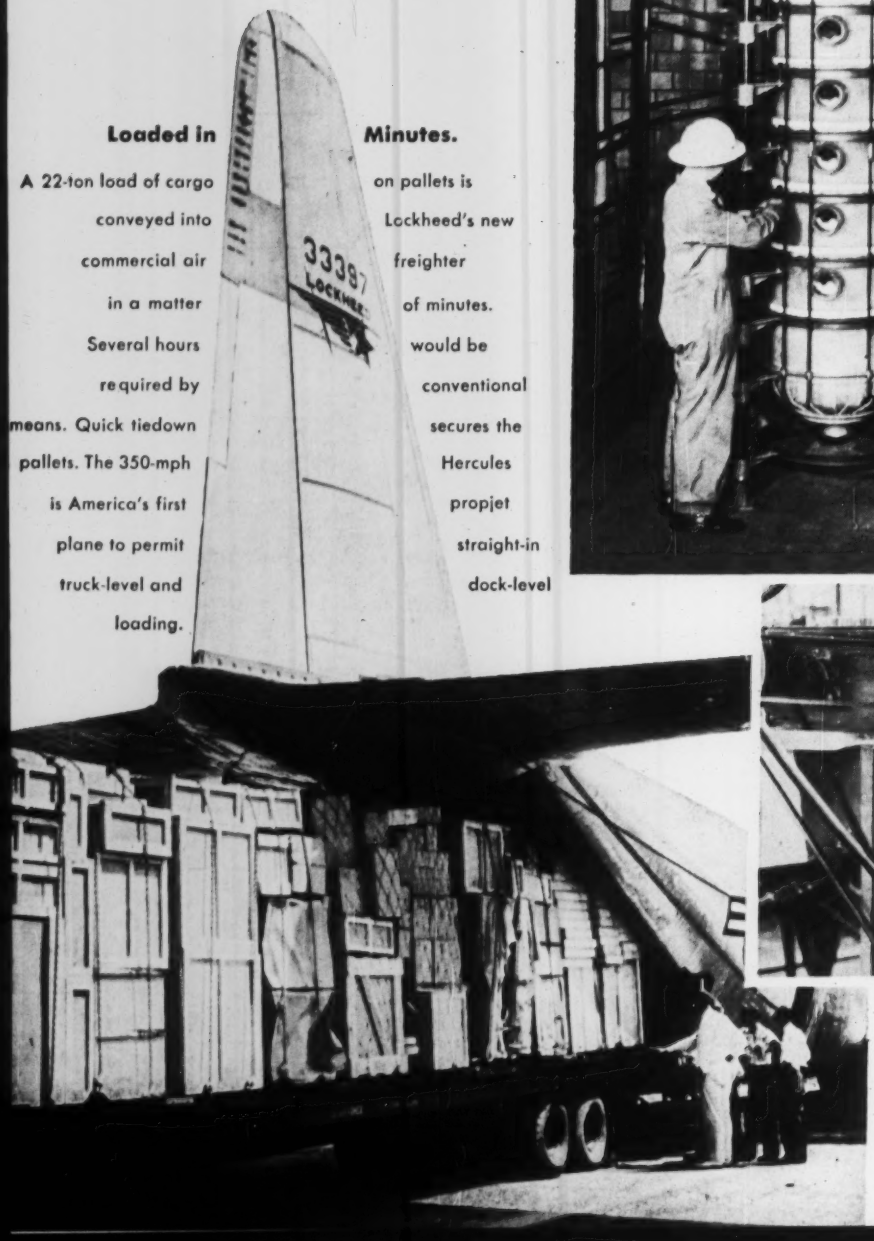
The soldering technique is equally effective for joining galvanized surfaces without a flux. Joints produced by this method are strong and stable.

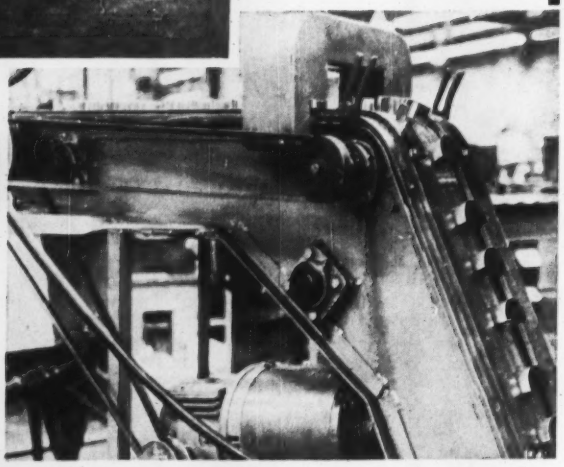
Photo Briefs



Glass Distillation. A 16-ft all-glass distillation column, weighing 2000 lb and 23½ in. in diam, has been manufactured by Corning Glass Works for use in the manufacture of metallic silicon

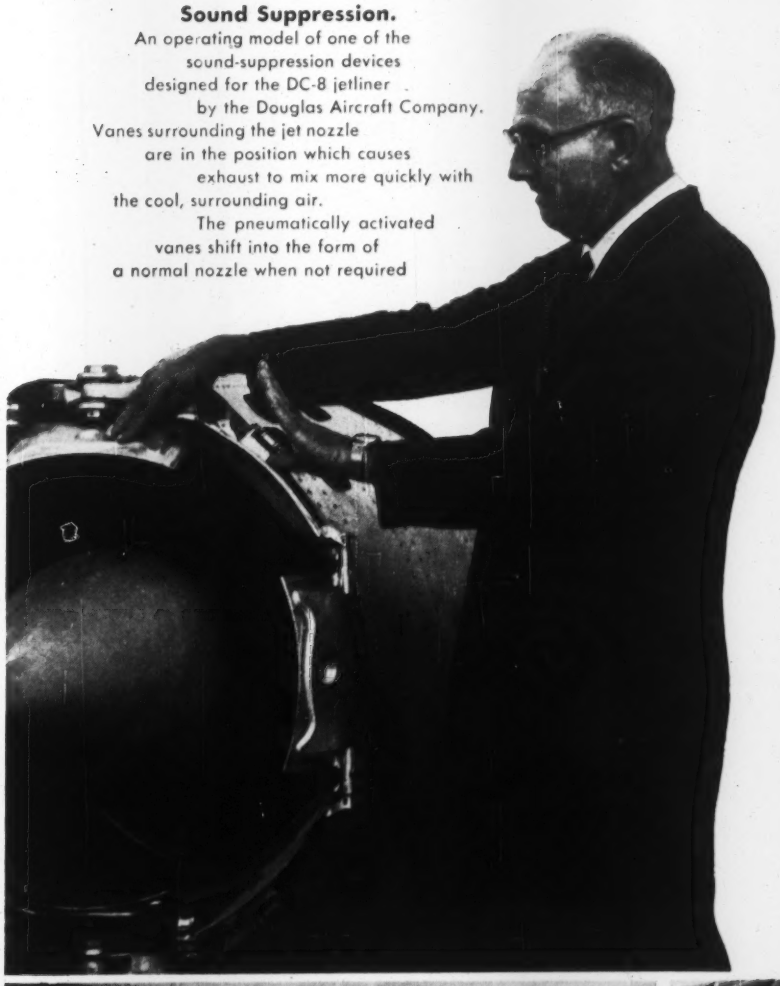
Loaded in Minutes. A 22-ton load of cargo on pallets is conveyed into Lockheed's new commercial air freighter in a matter of minutes. Several hours would be required by conventional means. Quick tiedown secures the pallets. The 350-mph Hercules propjet is America's first straight-in plane to permit truck-level and dock-level loading.





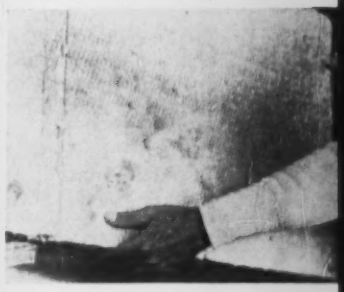
Nonskid Delivery. The close tolerances and mirror finish of bushings and bearings are easily marred. Sections of permanent magnetic Magna-Rail, made by Eriez Manufacturing Company of Erie, Pa., beneath the conveyer belt, hold pieces firmly until they are automatically released.

Sound Suppression. An operating model of one of the sound-suppression devices designed for the DC-8 jetliner by the Douglas Aircraft Company. Vanes surrounding the jet nozzle are in the position which causes exhaust to mix more quickly with the cool, surrounding air. The pneumatically activated vanes shift into the form of a normal nozzle when not required

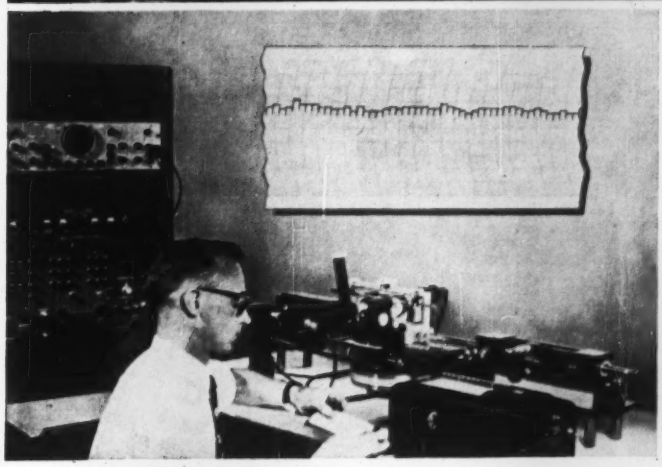


Duct Insulation. Pins 1½ in. long were welded to the air-conditioning duct surface at regular intervals.

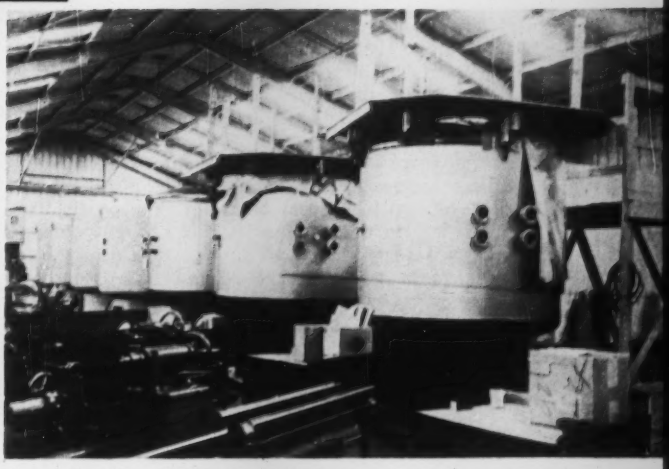
A section of the 30,000 sq ft of spun-mineral-wool insulation used in the Graflex, Inc. plant was cut with a knife and impaled on the pins.



Speed clips slipped over the welded pins hold the insulation snugly to the surface of the duct. Insulation was manufactured by Baldwin-Hill Company, Trenton, N. J.



Pitch Uniformity. Very small imperfections in the pitch uniformity of repetitive structures are measured rapidly and automatically with an instrument developed by Bell Telephone Laboratories: (1) An optical grating provides a very accurate distance scale, (2) positioning is ascertained optically, (3) the information is analyzed electronically by a computer which measures the variation and records it on a chart.



Mass-Produced Reactors. The tenth production-model AGN-201 nuclear reactor was exhibited at the New York Atomfair. Aerojet-General Nucleonics has been authorized by the AEC to manufacture 21 of them. Mass-produced in a production line at San Ramon, Calif., the low-power teaching and research reactors can be placed in operation in a few hours. A fissionable core is merely inserted, and 1000 gal of water added for shielding.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Nuclear Power for Ship Propulsion

A THREE-DAY Conference on Marine Turbines was held in the latter part of September in Stockholm, Sweden, by Aktiebolaget de Lavals Angturbin (the de Laval Steam Turbine Company) of that city. The high light of the conference was the presentation by Dr. T. W. F. Brown, Research Director of the Pametrada Research Station, Wallsend-on-Tyne, England, of the first de Laval Memorial Lecture. The lecture commemorated Dr. Carl Gustaf Patric de Laval (1845–1913), inventor of the centrifugal cream separator and of the de Laval steam turbine, and founder of the firm of the same name. The present year was selected for the inauguration of the memorial lecture because it marked the passage of 75 years since Dr. de Laval applied for his first turbine patent.

Dr. Brown took as his subject, "Propulsion of Ships by Steam Turbine Machinery," and presented an admirable survey of the development of marine steam-turbine machinery down to the latest practice, with some indication of expected improvements in performance. He considered that, by using steam at 1100 psig and 1200 F, with reheat to 1050 F, it should be possible to achieve a fuel-oil rate of 0.445 lb per shp/hr. The most interesting part of his lecture, however, was the section in which he considered the possible application of atomic energy to ship propulsion; to tankers of 60,000 tons dead-weight cargo capacity in the first instance, as this type of vessel offers the most favorable usage (80 per cent or better time at sea) and the best return on the heavy capital outlay.

Though the possible forms of reactor were numerous, said Dr. Brown, only three types were fully developed, these being the graphite-moderated gas-cooled type using natural uranium as fuel (i.e., the British "Calder Hall" type); the pressurized-water type employing enriched uranium, as used in the submarine *Nautilus* of the U. S. Navy; and the Russian type, using enriched uranium, graphite-moderated and water-cooled.

Schemes were worked out in some detail for the Calder Hall type, with natural uranium and, with varying degrees of enrichment, for the pressurized-water type, and for a projected design using natural uranium, with heavy water as a moderator and gas cooling. All were based on 22,000 shp and comparative weights were given. In respect to weight, the pressurized-water type showed to the best advantage with a total weight of 3390 tons, or 1170 tons less than an oil-burning steam-turbine installation of equal power, using steam at 650 psig and 950 F. The Calder Hall type using natural uranium worked out at 7815 tons, 3255 tons more than a conventional steam plant; but by using enriched uranium the excess weight could be reduced to no more than 40 tons. The saving of weight and space resulting from the use of enriched uranium was well brought out by illustrations of model layouts; with natural uranium the reactor pressure-vessel would be 64 ft high and 26.5 ft diam, but with the maximum practicable enrichment these dimensions would be only 30 ft and 15.5 ft, respectively. The cost (at British current rates) of a plant of the Calder Hall type would be about 7 million dollars more than that of conventional steam machinery and would bring the total cost of a tanker of 60,000 tons dead-weight cargo capacity to about the equivalent of 15 million dollars.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

An Extensible Steam Engine

A UNIT-CONSTRUCTION steam engine incorporating design features usually regarded as peculiar to the internal-combustion engine, and capable of being increased in power by adding more cylinders up to a total of six, has been put on the market by the West German firm of Spillingwerk G.m.b.H., of 5 Werftstrasse, Hamburg 11, and attracted considerable attention at the 1957 German Industries Fair at Hanover. Each unit consists of a crankcase section on which is mounted a cylinder block, and is totally enclosed. Steam distribution is by piston valves, actuated from an eccentric shaft, and can be adjusted for each cylinder independently of the others. The eccentrics rotate on needle bearings. The crankshaft block is so designed that it can be completely machined at one setting, and is fitted with a telescopic seal for the piston rod. The piston is of steel, with a cast-iron jacket in which are the grooves for the rings. The steam passages are straight and very short. All working parts are pressure-lubricated. Only two types of units are made, the smaller having a stroke of $2^3/_4$ in. and the larger, either 5 in. or $5^1/_2$ in., according to requirements. The small unit runs at 1500 rpm and delivers 40 bhp. The 5-in. stroke unit runs at 1000 rpm, at which speed it has a maximum output of 200 bhp. The engine with $5^1/_2$-in. stroke runs at 750 rpm and gives 160 bhp per cylinder. Up to five units can be coupled together in the cases of the $2^1/_2$-in. and $5^1/_2$-in. sizes, or six of those with 5-in. stroke. The eccentric shaft is made in sections corresponding in length to the width of the crankcases, so that the addition of another cylinder does not involve the provision of another shaft; but this does not apply to the crankshaft, which must be replaced by one with the necessary extra crank or cranks corresponding to the number of cylinder units added. Apart from this, and the replacement of the steam and exhaust manifolds by others with additional branches, the extension of an engine to afford a higher output involves no more than the bolting on and bolting

down of the requisite further units. All the components are interchangeable, and the external dimensions of the blocks are identical; thus the makers manage to cover the whole range from 10 hp to 1000 hp with only two types of cylinder blocks. The piston speeds range from 11.5 to 13.75 fps.

— and "Twin-Bank" Oil Engines

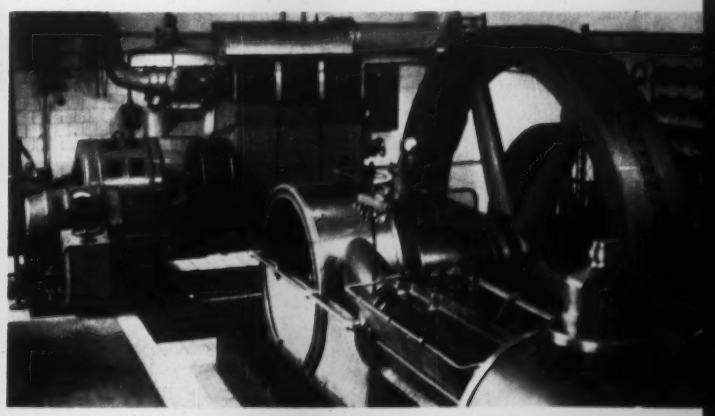
ANOTHER method of increasing the power range covered by a standard series of engine parts has been developed by an English firm, Blackstone & Co., of Stamford, Lincolnshire, England. For some time they have been building two series of in-line oil engines, the EV and ER types, with from two to eight cylinders, the largest size giving a maximum power output of 660 bhp at 750 rpm. While retaining some 80 per cent of the existing standard parts, they have more than doubled the power range by building the engines in twin side-by-side units, with the crankshafts coupled through nodal dampers to a single output shaft, and offering the alternatives of either normal aspiration or turbocharging. The cylinders have a bore of $8^3/_4$ in. and a stroke of $11^1/_2$ in., and a compression ratio of 14:1. The EV and EVS models run at 600 rpm and the ER and ERS at 750 rpm (the addition of "S" to the designation indicating that the type is supercharged); the turbocharger gives a boost pressure of 4 psi in the EVS type and $4^1/_2$ psi to the ERS. The two vertical banks of cylinders are bolted to each other, back to back, and stand on a common baseplate; but each bank is an individual engine, complete with its own governor, running gear, and pumps. Each crankshaft has a hydraulic damper at its free end and a flywheel at the other. The Blackstone nodal dampers are interposed between the flywheels and the input gears to the gearbox and give a flexibility of 5-deg twist on full load through rubber buffers in shear. The gearwheels and pinions are interchangeable, to give a choice of ratios at a fixed center distance, the range of ratios being from 1:1.57 to 1:0.71. For stationary plants, starting is by compressed air, but for traction duties series windings may be included in the generator to permit electric starting. For long-term running on low load, one bank may be closed down, its drive being disconnected at the input coupling to the gearbox; but, if desired, an additional clutching arrangement can be provided which will enable either bank to be isolated instantly. The two governors can be connected through a floating linkage, the mean deflection of which then controls the fuel pumps on both engines.

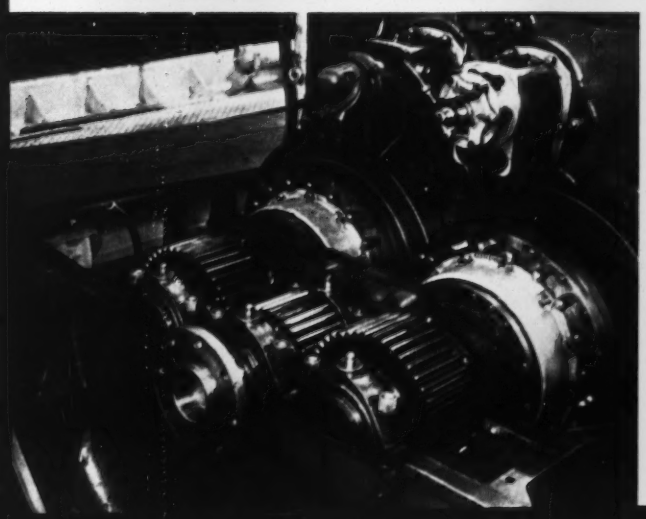
Blackstone twin-bank engine. ***Top:*** **General view of the 12-cyl type EVS12 in the test shop at the maker's works, Stamford, Lincolnshire, England.**

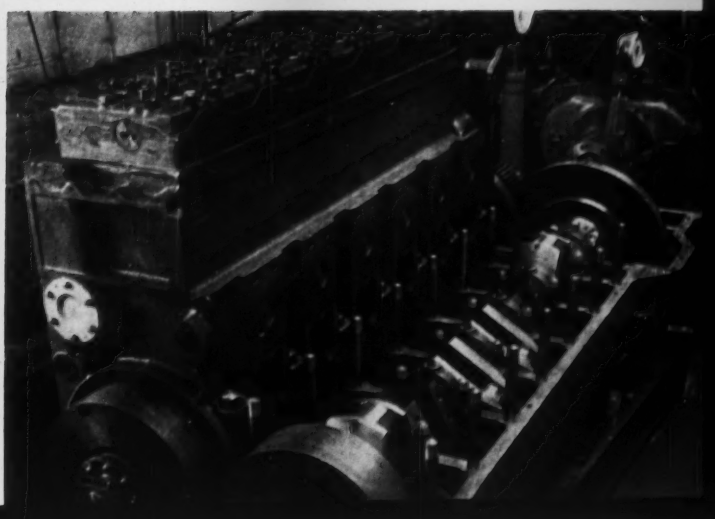
Blackstone twin-bank engine. ***Bottom:*** **Detail of drive arrangement showing the nodal damper coupling fitted to each crankshaft flywheel and the gear drive onto the output shaft.**

Spilling "steam motor." ***Top:*** **The old or horizontal-type steam engine is of 150 bhp. The 3-cyl spilling engine,** ***in background,*** **420 bhp at 750 rpm.**

Blackstone twin-bank engine. ***Bottom:*** **View of partly erected twin-bank engine with one-cylinder housing complete with cylinder heads in position.**







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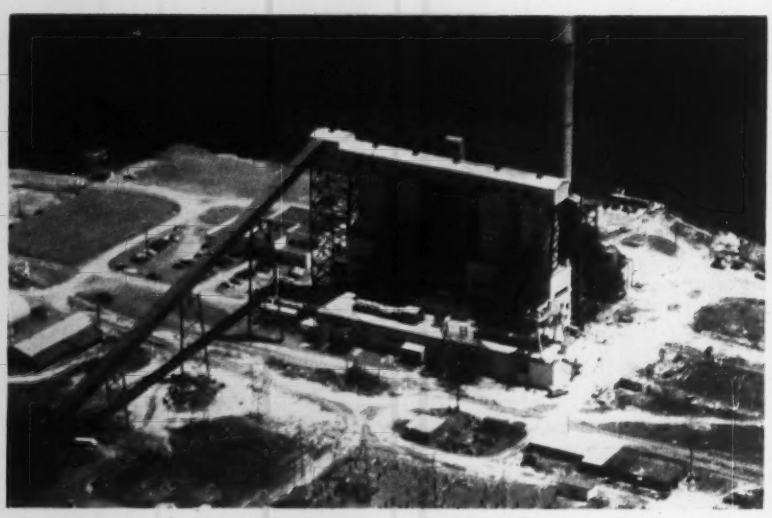


Martins Creek steam electric station—outdoor design of electric generating station for cold climates

Power

Martins Creek Steam Electric Station—New Ideas to Reduce Cost of Construction and of Operation, by M. D. Engle, Fellow ASME, Pennsylvania Power and Light Company, Allentown, Pa. 1957 ASME Power Conference paper No. 57—PWR-2 (multilithographed; available to August 1, 1958).

THE Pennsylvania Power & Light Company supplies electrical service in a 10,000-square-mile service area in Central Eastern Pennsylvania, the "Heart of the Market." The Martins Creek Steam Electric Station was placed in service in 1954. The station was designed for operation at low load factor, and the turbines and boilers are designed and instrumented for shutting down each night and over weekends and holidays and for starting up under "controlled start" procedures.

The station is the first large coal-burning station of the outdoor type as far north as Pennsylvania. Three winters of operation have demonstrated that a properly designed outdoor station is satisfactory for the Pennsylvania climate. Many new features of design were incorporated in the station to reduce the cost of construction and to reduce the cost of operation. These features are discussed in the paper. It is believed that many of these features can be used to advantage in other stations designed for other operating and climatic conditions.

A mechanical equipment list and a list of structural material supplies, as well as a list of contractors, are included also.

●

Controlled Starting and Loading of Modern Power Stations, by F. W. Kuehn, Mem. ASME, Pennsylvania Power and Light Company, Hazleton, Pa. 1957 ASME Power Conference paper No. 57—PWR-7 (multilithographed; available to August 1, 1958).

THIS paper outlines experiences in starting major central-station equipment of all vintages under controlled conditions with emphasis on a new 160-mw, 1250-lb, 950-F, single-shell tandem-compound turbine. The influence of steam leads between turbine and boiler on turbine end steam temperatures; quenching of valve bowls; and relation between horizontal turbine-flange temperature differentials and permissible loading rates are explained in detail. Use of steam from the first turbine stage for heating massive horizontal flange sections in the first to seventh-stage region of the high-pressure turbine as an operating routine, over a two-year period, to reduce loading time for starts from cold and after weekend shutdown and to minimize flange distortion is discussed. Boiler-drum circulation difficulties and remedies and some innovations in furnace tube-metal temperature measurements are covered.

●

Effect of Heated Condenser Discharge Upon Aquatic Life, by Richard Van Vliet, Pennsylvania Power and Light Company, Allentown, Pa. 1957 ASME Power Conference paper No. 57—PWR-4 (multilithographed; available to August 1, 1958).

THE effect of the discharge of heated condenser circulating water upon aquatic life in the vicinity of steam electric generating stations is the subject of this paper.

During the protracted drought in the Delaware watershed during the early summer of 1955, the river flow became critically low. Following the recommendation by the Industrial Wastes Division of the Pennsylvania Department of Health to the Sanitary Water Board that the temperature rise in streams receiving condenser discharge water be limited, Pennsylvania Power and Light Company contracted with the Lehigh University, Institute of Research to make a study in an effort to determine the effect of such discharge upon aquatic life.

Studies were made of river temperature distribution, its chemistry, the number and kind of planktonic organisms, algae growth, rooted aquatics, invertebrates, and river fish.

Observations and experiments have not been concluded; however, this paper summarizes two interim progress reports describing the work accomplished in 1956.

●

Nuclear Power Trends, by W. T. Moore, Mem. ASME, The Babcock & Wilcox Company, New York, N. Y. 1957 ASME Power Conference paper No. 57—PWR-9 (multilithographed; available to August 1, 1958).

A GOOD nuclear power design must result in a safe plant which will produce power at a cost per kwhr which is competitive with existing fuels.

Discussion in this paper is confined to solid-fuel element reactors and fluid-fuel reactors. The major problems with solid-fuel element reactors are the chemical processing of the spent fuel elements to separate the plutonium or uranium-233, and the fabrication of other fuel elements from these highly radioactive materials. In fluid-fuel reactors the separation problem is less difficult. There are, however, extremely difficult problems of maintenance and replacement, particularly if such reactors are externally cooled so that the fuel solution is circulated through a primary system that is loaded with millions of curies of radioactivity—orders of magnitude more active than a solid fuel reactor system—and which can be decontaminated only to a certain extent.

Information pertaining to two pressurized-type reactors—the Consolidated Edison Thorium Reactor being built at Indian Point on the Hudson River, and the Nuclear Merchant Ship Reactor being built for the Atomic Energy Commission for installation in a vessel to be built for the U. S. Maritime Administration—is presented in this paper.

●

Pennsylvania Advanced Reactor—Process Description, by S. C. Townsend, Pennsylvania Power and Light Company, Allentown, Pa., W. E. Johnson, and D. H. Fax, Assoc. Mem. ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1957 ASME Power Conference paper No. 57—**PWR-13** (multilithographed, available to August 1, 1958).

THE Pennsylvania Advanced Reactor Project has been in operation almost two-and-a-half years. The plant process is described in this paper.

The primary system contains the heat source, that is, the reactor and its associated piping and circulating pumps, and the primary steam generators. Gases produced in the reactor vessel are sent to the gas recombination system, which recombines the dissociated heavy water and returns the bulk of it to the primary system. The noncondensable gases which remain, and a small fraction of the heavy water vapor, are carried by a helium stream to the off-gas system where the remainder of the water vapor is condensed and returned to the plant. The radioactive fission product gases which remain are allowed to decay to the point where, after dilution with air, they may be safely vented to the stack.

The fuel-handling system is employed mainly during nonsteady-state operation of the plant. Filling the primary system on start-up, draining it during shutdown, the more routine adjustments of fuel concentration are among the functions of this system. A small stream of fuel mixture drawn from the primary system is sent to the chemical processing system, which in this design is integrated with and on the same site as the reactor plant. The chemical processing removes the nonvolatile fission product poisons from the fuel, reconstitutes it as a slurry and returns it to the reactor through the fuel-handling system. Additions of fresh fuel as needed and the storage or safe disposal of solid and liquid wastes are additional functions of the chemical processing system.

The processes in each of these systems and some of the considerations which affect the choices of the design parameters, are described in detail in this paper.

●

Ultrasonic Detection of Thin Laminar Inclusions, by S. Serabian and C. D. Moriarty, Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Power Conference paper No. 57—**PWR-11** (multilithographed, available to August 1, 1958).

AN INVESTIGATION of the effect of thickness and composition of an inclusion on its ultrasonic reflectivity is reported in this paper.

Ultrasonic inspection is one of the most sensitive tests that can be applied to material. In fact, its ability to detect thin laminar flows, when x ray failed to do so, brought it into prominence as an inspection tool for wrought material. In the x-ray transmission method, the lower limit of inclusion thickness detectability is a function of x-ray wave length and composition of the inclusion. What has apparently not been fully appreciated is that, in the ultrasonic reflection method, the lower limit of inclusion thickness detectability is also a function of wave length and composition.

As a matter of interest, a glass plate less than 0.070 in. thick, and an air gap less than 0.020 in. thick, became undetectable by x rays powerful enough to penetrate a few feet of steel. These values are relatively independent of thickness of steel when using supervoltage x rays. Compare this to ultrasonics at 1.0 megacycles wherein the glass would have to be less than 0.010 in. thick, and the air gap less than 0.02 microinches thick, according to the theory.

Further work is in progress to form thin laminar inclusions of different compositions in wrought steel for the purpose of studying their effect on ultrasonic detectability. Successive forging, sonic testing, and electron microscopic examination may shed more light on ways of insuring that thin laminar inclusions are detectable ultrasonically.

Until more is known about these microseparations, an ultrasonic test of critical material should be made after the strains produced during the various stages of production have had an opportunity to create such microseparations. In the case of rotating components, ultrasonic testing after full-speed operation is advisable.

The information presented in this paper should be considered as merely focusing attention on a heretofore generally unknown aspect of ultrasonic inspection. The lack of such information is evident when one views the literature pertaining to ultrasonic inspection, and in the unfamiliarity of the field of nondestructive testing with this problem and its implications. Needless to say, investigations and evaluations conducted under various circumstances will be necessary before all of the facets bearing on the problem of ultrasonic reflectivity from thin laminar inclusions are understood. Meanwhile, there is sufficient evidence at hand to state the following:

1 Thickness and composition of thin laminar inclusions are important factors affecting the magnitude of the ultrasonic reflection obtained therefrom.

2 The magnitude of ultrasonic reflections from thin laminar inclusions can change with times and/or service conditions, if microseparations are formed.

3 Conventional optical microscopic examination is inadequate for full evaluation of the microseparations which can cause appreciable ultrasonic reflectivity changes. The electron microscope, with its greater resolving power, may be necessary in the examination.

4 The presence of microseparations associated with an inclusion does not significantly affect the mechanical properties, although they do drastically affect ultrasonic reflectivities. In short, the problem lies in the lack of ability to detect a thin laminar inclusion of a large area when there is an absence of microseparations.

●

Operating Experience With High-Temperature Steam Rotors and Design Improvements in Rotor Blade Fastening, by J. C. Conrad, Mem. ASME, and N. L. Mochel, Mem. ASME, Westinghouse Electric Corporation, Lester, Pa. 1957 ASME Power Conference paper No. 57—**PWR-10** (multilithographed, available to August 1, 1958).

Two instances of cracking in turbine

rotor-blade groove walls have been encountered in the intermediate pressure rotors of single shaft, tandem compound, three casing, triple exhaust reheat turbines. The first occurred in a nickel-chromium-molybdenum-vanadium steel rotor at TVA Shawnee Station, Unit No. 1; and the second, in a forging of chromium-molybdenum-vanadium steel in Consumers Power Company's Weadock Station, Unit No. 7.

This paper reports the results of the investigations arising from those experiences, and the examination of similar rotors in other Westinghouse-built turbines.

The nickel-chromium-molybdenum-vanadium steel has a wide scatter in creep rupture strength above 900 F and in some cases may undergo metallurgical changes above 950 F. Modifications employing a combination of cooling and reduction of stress appear to have been effective in protecting rotors where operating metal temperatures were over 900 F. This material is no longer used for designs in which metal temperatures, in excess of 900 F, are expected.

The chromium - molybdenum - vanadium steel using the earlier heat treatment with an austenitizing temperature of 1850 F is particularly notch sensitive. Cooling and reduction of stress concentration are important factors in raising the margin of safety of rotors using this material and heat treatment.

The chromium-molybdenum-vanadium steel using the later heat-treatment with an austenitizing temperature of 1750 F is a much improved material with respect to notch sensitivity at elevated temperature.

Greatly accelerated development studies have led to an improvement in blade fastenings, locking devices, and the application of cooling to critical zones resulting in lower stresses and better use of available materials.

●

Investigation of the Generator Rotor Burst at the Pittsburgh Station of the Pacific Gas and Electric Company, by D. R. De Forest, L. P. Grobel, C. Schabtach, Mem. ASME, and B. R. Seguin, General Electric Company, Schenectady, N. Y. 1957 ASME Power Conference paper No. **57—PWR-12** (multilithographed; available to August 1, 1958).

THE recent fracture of a large, 125,000-kw, 3600-rpm, generator rotor led to an extensive investigation to determine its cause. The fracture occurred during an overspeed-governor trip test of the 169,118-kva Pittsburgh Unit No. 1 of the Pacific Gas and Electric Company.

The rotor body burst lengthwise into two half-cylinders. The two halves then broke into smaller pieces.

Visual examination of the fractured surfaces as the fragments were removed from the stator indicated that the origin of the burst was located in one fragment, about ten feet long, of the main body. The origin of the fracture was an area about 5 in. long axially by 2 in. wide radially, located about 30 in. from the collector end of the body and nearly on the axis. This 2-in. × 5-in. area had a "woody" or fibrous appearance different from that of the fracture surface surrounding it. The presence of fracture striations emanating from this "woody" area indicated that this was the origin of the fracture.

To ascertain if there were any abnormalities in the rotor (obviously not apparent in the acceptance test results) which might explain the low average-stress-level burst, numerous tests, such as mechanical, notched bend, fatigue and others, were obtained on specimens from the rotor fragments. A brief summary of these test results is presented in the paper.

The results of this investigation reemphasize the need for improvement of the homogeneity and toughness of large rotors. Work in this direction had been under way for three years when analysis of an earlier burst indicated a need for improvement of rotor forgings in three major respects:

1 Quality—or freedom from porosity, hydrogen flakes, thermal cracks.

2 Homogeneity—or freedom from inclusions, segregations, variations in grain structure.

3 Toughness—or the ability of the material to resist the initiation and propagation of cracks.

Significant progress has been made toward all of these objectives with the able assistance and excellent co-operation of the large forging suppliers.

●

Design Considerations in the Development of a Cyclone-Fired Boiler Installation, by R. L. Young, Eastman Kodak Company, Rochester, N. Y. 1957 ASME Power Conference paper No. **57—PWR-1** (multilithographed; available to August 1, 1958).

THE engineering of a cyclone-fired, 1400-psi pressure, steam-electric generating plant is the subject of this paper. The economic and technical problems encountered in the application of this firing method and 1400-psi pressures to an industrial power system, are discussed also.

Basically, the plant was designed and constructed to supply steam, but in addition it was to furnish by-product electric power at a cost competitive with purchased power.

The industrial power installation having an open steam and feedwater cycle can produce low-cost electric power as a by-product of steam. The attempt, however, to secure a greater amount of electric power for each pound of steam generated by the use of 1400-psi or higher pressure and to lower capital cost by application of large steam-generating units to an isolated system presented serious problems which were given careful analysis in the design of this installation.

The cyclone-fired boiler furnished the means of resolving certain technical and economic issues peculiar to this system and its environment, but also introduced other factors for consideration.

It is felt that most of the system requirements have been satisfied, but it remains for extended operating experience to supply the final proof of adequacy.

●

Unusual Features of the Portland Combustion Control System, by E. D. Scutt, Mem. ASME, Leeds and Northrup Company, Philadelphia, Pa. 1957 ASME Power Conference paper No. **57—PWR-8** (multilithographed; available to August 1, 1958).

THE combustion control system for the Portland Station employs new concepts for co-ordinating operation of the boiler and turbine as a unit. A detailed discussion of the unusual features of the system is included in this paper. These features can best be summarized by the following:

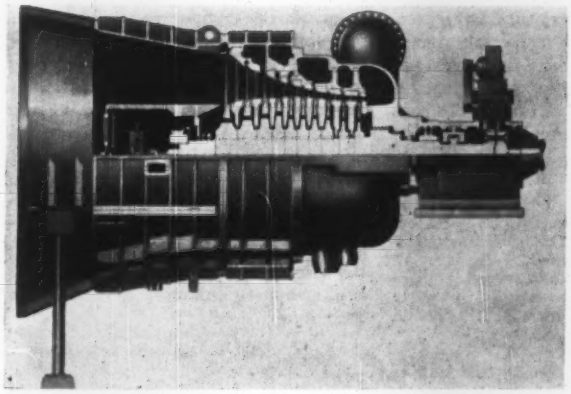
1 Two basic methods of operation are provided; namely, the "direct energy balance" and the "conventional" methods.

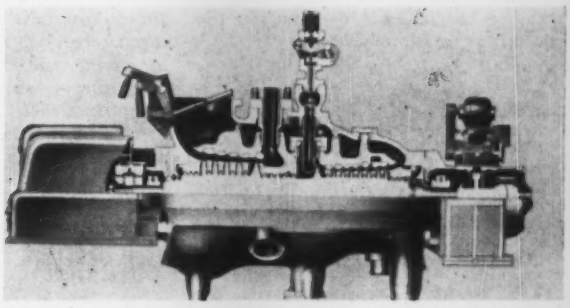
2 A boiler-turbine governor component integrates operation of the boiler and turbine as a unit and keeps the output within the capabilities of the auxiliary equipment in service.

3 The steam flow measurement normally found in conventional combustion control systems has been replaced by electrical generator output.

4 Final adjustment of air flow is automatically controlled from oxygen to maintain optimum combustion.

This method of control is being employed on the six once-through boilers under design and construction by Combustion Engineering in this country. Three of these units are for supercritical pressures, while the remaining three are for subcritical operation. The first unit,





Quarter section views of high-pressure, 3600-rpm turbine element with reheat section, *above;* and 1800-rpm axial-flow, low-pressure turbine element, *left.* 150,000-kw cross-compound unit, Metropolitan Edison Company, Portland Station.

which incidentally is for subcritical pressure, is expected to go into operation in the Spring of 1958. This control approach is currently being tested at Titus Station.

The close correlation between actual field operation and the computer simulation studies for Titus and other recent boiler installations has been most gratifying. The use of computer simulation techniques should greatly reduce the necessary time for field adjustment of control systems in the future and will greatly aid in securing improved control operation.

●

The Condenser at Portland, by G. T. Jones, Ingersoll-Rand Company, New York, N. Y. 1957 ASME Power Conference paper No. **57—PWR-14** (multilithographed; available to August 1, 1958).

THE condenser at the Portland Station of the Metropolitan Edison Company was built to incorporate all of the proved features important to efficient heat-transfer performance and simultaneously to be suitable for use with the axial-flow exhaust turbine.

The condenser would have to have a divided cooling-water circuit so that the tubes could be cleaned readily without taking the turbine off the line, and the water circuits would have to be reversible for flushing away debris from the water boxes and tube sheets. The water circuitry would have to be compatible with the desired aerodynamic characteristics of the exhaust flow path, and the air coolers within the condenser would have to be designed to accommodate this flexible water circuitry. The air-removal equipment operating with the condenser air coolers would have to be adequate at the lowest absolute pressures, for the condenser must deaerate the condensate in so far as practical. The condenser hotwell would have to reheat and contain in live storage a large quantity of condensate. The fastening of tubes to tube sheets would have to be tight, and permanently tight, for even a modicum of solids build-up in the boiler water could be hazardous. The condenser would have to handle large dump steam flows without allowing excessive heating of the turbine exhaust blading and hood. The condenser would have to be flexibly supported at the same elevation as the turbine while bolted rigidly to the turbine exhaust flange. With these requirements in mind, there evolved the new and unique condenser design which is the subject of this paper.

●

Design Features and Development of the Cross-Compound, Single Flow Turbine With Axial Exhaust—for the Portland Station, by J. E. Fowler, Mem. ASME, and C. Matney, Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Power Conference paper No. **57—PWR-6** (multilithographed; available to August 1, 1958).

THE cross-compound, 3600-rpm, high-pressure turbine element with the reheat section and the 1800-rpm, single-flow, low-pressure element is discussed in this paper.

The cross-compound design presents several attractive possibilities in the arrangement of components for improved performance and naturally leads to an opposed-flow, 3600-rpm, high-pressure element. This type of unit design permits a station layout which offers the station designer new opportunities for reduction in station building costs.

The use of a single-flow low-pressure element enables the turbine designer to incorporate an axial-discharge exhaust hood in which a significant portion of the kinetic energy in the exhaust can be recovered.

The evolution of the axial-flow exhaust hood is described in detail and the test results are shown with the expected improvement in the over-all operating economy. The first boiler-turbine-condenser arrangement of this type is the 150,000-kw cross-compound unit being installed in the Portland station of the Metropolitan Edison Company.

Lubrication

Self-Excited Vibrations of an Air-Lubricated Thrust Bearing, by L. Licht, Assoc. Mem. ASME, New York, N. Y., D. D. Fuller, Mem. ASME, Columbia University, New York, N. Y., and B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASLE-ASME Lubrication Conference paper No. **57—LUB-2** (multilithographed; to be published in Trans. ASME; available to August 1, 1958).

THE present trend toward high speeds, high temperatures, radioactive atmospheres, and low frictional requirements has renewed interest in gas lubricated bearings. There are several very important factors to be considered before compressible fluids can be employed efficiently in bearing design. This paper does not concern itself with the compressor power consumption or bearing load-carrying capacity, but rather with the troublesome problem of instability. In this paper, an approach to the investigation of the stability of an air-lubricated thrust bearing is presented.

The stability analysis is based on a number of simplifying assumptions. It is not intended to provide definite design parameters, but rather to indicate the primary causes of the undesirable "air-hammer" phenomenon, to establish

stability criteria, and to point out the parameters which influence it.

●

Surface Deformations in the Hydrodynamic Slider-Bearing Problem and Their Effect on the Pressure Development, by F. Osterle, Assoc. Mem. ASME, and E. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1957 ASLE-ASME Lubrication Conference paper No. **57—LUB-3** (multilithographed; available to August 1, 1958).

THE results of work done on the problem of the effect in hydrodynamic slider-bearing lubrication of elastic surface deformations are presented in this paper. Two problems have been treated. In both, the bearing is considered to deform as an elastic semi-infinite solid. In the first problem, the slider is taken to be perfectly rigid and of fixed inclination, and in the second, it is treated as a pivoted flexible plate. In both of these problems we find the pressure distribution for a given minimum film thickness and compare it with the pressure distribution which would be calculated for this minimum film thickness by the usual methods which assume perfectly rigid surfaces. The load capacity and surface deformations also are determined. The method of solution is a perturbation scheme which relies on the smallness of the elastic effect. The numerical work was done on an IBM-650 digital computer and the results are presented in dimensionless plots. Several detailed examples are worked out.

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Current Development Problems in High-Temperature Aircraft Roller Bearings, by C. C. Moore, Assoc. Mem. ASME, General Electric Company, Evendale, Ohio, and F. Lewis, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASLE-ASME Lubrication Conference paper No. **57—LUB-4** multilithographed; available to August 1, 1958).

CORROSIVE oxidation products of lubricants in high-temperature bearings appear to be among the main stumbling blocks in the development of high-temperature bearing systems. These oxidation products have three adverse effects: (*a*) Rolling bearing fatigue life is reduced as much as 7 to 1 at a microscopic corrosion level. (*b*) Gross corrosion wear of rolling bearing material can occur in the order of 0.015 in/hr when operated with diester lubricants at 700 F. (*c*) Filters, jet nozzles, control systems, and other components are clogged and made inoperative due to coke and sludge oxidation products. These conditions have not been generally encountered up to the present time in main bearings in gas turbines because lubricant temperatures are too low. However, they have been encountered in high-temperature test equipment, and the purpose of this paper is to review some of this information and project these effects into future gas-turbine lubrication-system designs.

●

The Behavior of the Lubricating Film and Side Leakage Dynamically Loaded Bearings, by M. N. Ozdag, Istanbul Teknik Universitesi, Istanbul, Turkey. 1957 ASLE-ASME Lubrication Conference paper No. **57—LUB-5** (multilithographed; to be published in Trans. ASME; available to August 1, 1958).

AN INVESTIGATION was carried out in order to determine the behavior of the lubricating film in bushings having oil entry by means of a single hole, an axial groove, or a circumferential groove, under static or sinusoidally varying load.

Cavitation occurred, except for lightly loaded bearings, under static or dynamic loading conditions. Under sinusoidal loads, up to the maximum load alternation used in the tests (500 per min), the film could form and reform at each loaded region of the bearing. In doing this the load-supporting film moved intermittently within the clearance space in the direction of shaft rotation at a speed equal to the alternation of the cyclic load. The effect of this behavior on bearing frictional characteristics should be investigated.

The side-leakage flow from the bearing was found to depend on the ratio N_p/N_j, and a minimum in side leakage was observed at the value $N_p/N_j = 0.5$, which is also critical from the point of view of load capacity.

●

Isoelasticity in Gyro Rotor Bearings, by F. W. Ortman and H. M. Green, General Motors Corporation, Sandusky, Ohio. 1957 ASME Fall Meeting paper No. **57—F-34** (multilithographed; available to July 1, 1958).

DRIFT of a precision gyroscope has become a more serious problem to designers and manufacturers as performance specifications are tightened. Although there are many components in a typical gyro which permit mass shifts under external loads, this paper will consider only those effects associated with rotor bearings.

Drift of a precision gyroscope, under external loads, from an initial orientation is caused in part by a shift in the center of gravity of the rotor with respect to the gimbal axis. The shift or yield is the resultant effect of the external loads acting upon all elastic components which make up the gyro. Since rotor and gimbal bearings are included in the more elastic components group, it is desirable that their behavior be predicted with a high degree of accuracy. In this paper, design information is presented which may lead to an isoelastic bearing pair or to a bearing pair having specified axial to radial yield-rate ratios. Owing to nonlinear yield rates of bearings, the degree of departure from a true isoelastic bearing pair is calculated for a specific bearing configuration under the influence of a constant load at loading angles ranging from the axial to radial directions.

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Theoretical and Experimental Analysis of Hydrodynamic Gas-Lubricated Journal Bearings, by B. Sternlicht, Assoc. Mem. ASME, and R. C. Elwell, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Fall Meeting paper No. **57—F-18** (in type; to be published in Trans. ASME; available to July 1, 1958).

GAS-LUBRICATED bearings in recent years have aroused a great amount of interest. The interest is centered on the advantages of gas bearings for four major applications: (*a*) High-temperature devices, for which there is yet no lubricant available. (*b*) Radioactive atmospheres, where conventional lubricants may break down. (*c*) Applications sensitive to contamination, such as jet engines, where fouling from lubricating oil becomes serious. (*d*) Low-friction devices—an especially important advantage because of the trend to high-speed machinery.

This paper presents a numerical solution for finite-width journal bearings and results of experiment conducted with air-lubricated hydrodynamic journal bearings. Comparison is made between theoretical and experimental results. Design formulas and recommendations for future studies also are included.

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Solution of Reynolds Equation for Finite Journal Bearings, by O. Pinkus, Assoc. Mem. ASME, General Electric Company, West Lynn, Mass. 1957 ASME Fall Meeting paper No. **57—F-12** (in type; to be published in Trans. ASME; available to July 1, 1958).

REYNOLDS differential equation for finite bearings was solved for journal bearings having 100 and 75-deg arcs, using a digital computer. These results were applied to partial bearings as well as to 3-groove and 4-groove full journal bearings. Results are given for L/D ratios ranging from $1^1/_2$ to $^1/_4$ and eccentricities up to 0.95. These results were correlated with previous results for different bearing arcs obtained by others and the author, to provide a comprehen-

sive set of solutions of Reynolds equation for finite bearings from a full 360-deg arc down to an arc of 75 deg. Expressions for calculating minimum film thickness, total oil flow, power loss, and temperature rise, also are given.

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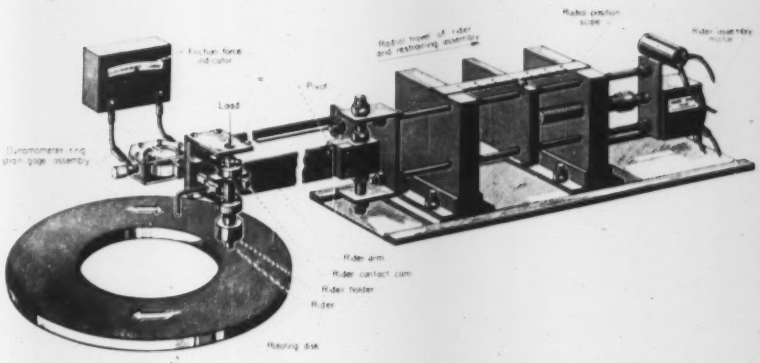
On Friction and Lubrication at Temperatures to 1000 F With Particular Reference to Graphite, by E. E. Bisson, ASME, R. L. Johnson, and W. J. Anderson, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1957 ASLE-ASME Lubrication Conference paper No. 57—LUB-1 (multilithographed; available to August 1, 1958).



Kinetic friction apparatus for high-temperature friction and wear studies. Frictional force between the rider and disk is measured by strain gages mounted on a beryllium-copper dynamometer ring.

HIGH-TEMPERATURE lubrication studies have been conducted in both sliding friction and small-scale rolling-contact bearing apparatus. Graphite effectively lubricated various metal combinations at 100 and 1000 F but not at all intermediate temperatures. The generally accepted theory (that graphite lubricates because of absorbed water or gaseous films) seemed incapable of explaining the results at 1000 F; therefore a supplementary hypothesis is advanced.

It is hypothesized that effective lubrication is possible with graphite, provided either of two conditions is met: (*a*) An adsorbed water or vapor film is present; or (*b*) an oxide film of the proper type is continuously present on one or both of the lubricated surfaces. The oxide film is believed to influence the adherence of graphite to the surface. Oxides or salts of soft metals were mixed with graphite to improve adherence of graphite to metal surfaces.

Several mixtures provided effective lubrication at all temperatures from 100 to 1000 F. Rolling-contact-bearing studies were made with both liquid and solid lubricants under various atmospheres. Liquids were effective at temperatures to 850 F provided the oil-oxygen ratio was maintained appreciably greater than stoichiometric. MoS_2 was effective at 1000 F in nitrogen as compared to 850 F in air. For temperature levels higher than those possible with liquid lubricants, gaseous lubricants capable of extreme pressure action in boundary lubrication have promise.

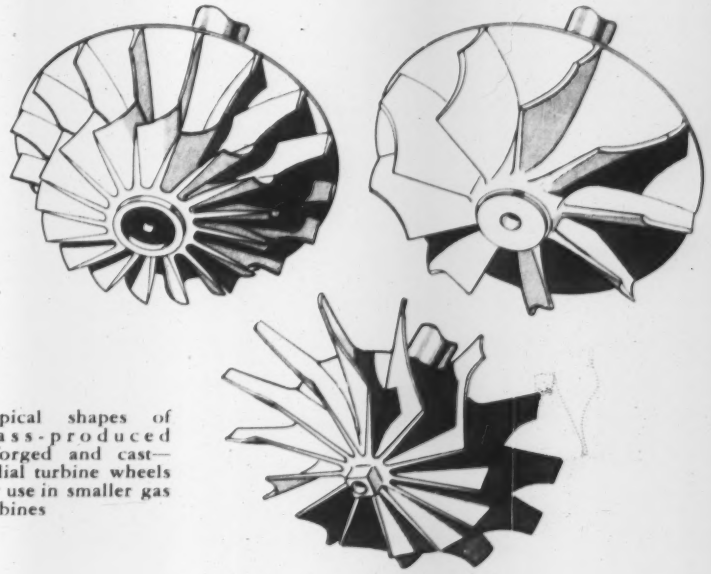
Gas Turbine Power

General Design Considerations for Smaller Gas Turbines, by W. T. von Der Nuell, The Garrett Corporation, Los Angeles, Calif. 1957 ASME Fall Meeting paper No. 57—F-13 (in type; to be published in Trans. ASME; available to July 1, 1958).

SMALLER gas turbines are gaining increasing acceptance among power producers. One of the advantages of turbines is their capability of consuming the prepared working substance at great through-flow velocities with pleasant operational smoothness. Having become a standard for stationary installation, they are gaining ever-increasing interest for mobile equipment with economical considerations of all-embracing scope determining success or failure believed to be in their favor. The two outstanding aspects are technical promise and/or perfection and manufacturing feasibility.

Very good over-all performance characteristics have been demonstrated and improvements are progressing well, enhanced by advanced knowledge in the field of gas dynamics. As for manufacturing, at the risk of slight exaggeration, can it not be said that production engineers always have and always will find methods of manufacturing products economically when there exists a genuine demand and the required materials are available?

Some performance features of smaller gas turbines are presented. Examples of different configurations and applications are also noted.



Typical shapes of mass-produced —forged and cast— radial turbine wheels for use in smaller gas turbines

Development problems are considered first from a general point of view and then specifically in terms of compressors; bearings and accessories and miscellaneous items; heat exchangers; materials and manufacturing.

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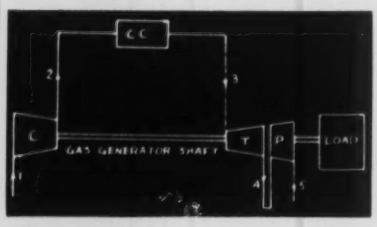
Dynamic Response Characteristics of Gas Turbines, by S. L. Soo, Assoc. Mem. ASME, Princeton University, Princeton, N. J., and W. W. S. Charters, Rolls-Royce Limited, Darby, England. 1957 ASME Fall Meeting paper No. 57—F-22 (multilithographed; available to July 1, 1958).

USEFULNESS and control requirements of almost all gas-turbine plants except those of the simple cycle, nonregenerative, constant speed design, depend upon dynamic stability. Dynamic stability affects the operating flexibility from idling to full load of simple cycle plants with split power turbines or jet propulsion. Other items of interest are the accelerating fuel requirement and runaway characteristics of regenerative plants, and the choice of arrangement of multishaft plants. Knowledge of dynamic stability enables the determination, for instance, of desirable characteristics of an acceleration limiter system.



Dynamic response characteristics of gas turbines are studied on simple Brayton cycle gas turbine set with a free power turbine. C = compressor, CC = combustion chamber, T = gas turbine, and P = power turbine.

The case of the simple Brayton cycle gas-turbine set with a free-power turbine is analyzed. This type of arrangement has been most popularly adopted for its versatility for either constant speed or propeller law drive, and for its flexibility and its favorable off-design characteristics. The case with a regenerator is also included to demonstrate the effect of thermal lag. Relations are presented, as far as possible, in dimensionless forms for the sake of generality.

The following conclusions were reached:

1 The dynamic stability criterion for load response of a simple Brayton cycle plant with split turbine is

$$\eta_c \eta_T \frac{T_{30}}{T_1} \left(\frac{p_1}{p_{30}}\right)^2 \left(\frac{V_{ao}}{U_0}\right)^2 \frac{(x^2 - W_{e/o} W_T)}{(1 - y^b_o)} \gg 0$$

and the response time scale is given by

$$\frac{k-1}{k} \frac{\eta_c \omega_o}{J 2\pi} \frac{M}{l p_1} \frac{k^2_r}{r_c^2}$$

These parameters suggest units of high component efficiencies, high maximum temperature, low cycle-pressure ratio, high compressor-flow coefficient, fewer machine stages, low cycle-pressure drops, smaller design speed, small rotating mass, high compressor-inlet pressure, and large blade height or small hub-to-tip-diameter ratio.

2 High-compressor stability against surge, or capability of reduced flow is significant in obtaining dynamic stability.

3 Proper proportioning or possibility of adjustment of flow capacities of high and low-pressure turbine is significant in maintaining operating stability of a split shaft design.

4 Thermal lag of a regenerator depends on

$$W_R C_R / m c_p \quad \text{and} \quad \eta_R$$

High thermal lag calls for additional fuel capacity beyond that for dynamic response.

5 The desirability of high compressor-inlet pressure suggests the use of closed-cycle gas turbine. In the case of open cycles, this criterion suggests the multishaft or twin-spool arrangement. Moreover, it suggests the high-pressure shaft as the main gas-generator shaft or variable speed shaft.

6 More accurate analysis than this first-order approximation requires thorough knowledge of cascade characteristics in accelerating or decelerating flow.

●

Manufacturing Small Engines, by L. W. Waitt, General Electric Company, West Lynn, Mass. 1957 ASME Fall Meeting paper No. 57—F-20 (multilithographed; available to July 1, 1958).

THE manufacture of small engines is complicated by the need for achieving lighter weight and closer tolerances. This paper illustrates problems in techniques, methods, and equipment which must be overcome. The change-over from large-engine to small-engine manufacture is discussed in relation to the J47 and T58 engines.

The J47 engine is 36.75 in. in diam and 144 in. long. The General Electric T58 turboshaft engine is 16 in. in diam and only 55 in. long. The J47 developed 5820 lb thrust and weighed 2520 lb. The T58 develops 1050 hp and weighs only 250 lb without gearing. For comparative purposes, 1 lb of thrust is considered as 1 hp. It can be seen that there is a power-to-weight ratio of 2 to 1 in favor of the small engine.

When the engine is reduced in size, however, not only are dimensions reduced but the tolerances as well. Many of the parts have to be precision machined for weight control only. To obtain the maximum strength-to-weight ratio and keep the over-all size of the engine small, the use of aluminum and magnesium casting has almost been eliminated; they are being replaced by thin, lightweight fabrications.

To illustrate the extent to which weight is controlled, the use of metal-arc welding has practically disappeared on small engines because a $^3/_{32}$-in. bead, which is the smallest that can be applied practically, is three to four times the thickness of the parent material. Inert-arc welding or high-temperature brazing in fabrications has been substituted.

To obtain required high strength at minimum weight, heat-treatable materials such as Chromalloy, which is a low chrome-moly alloy steel, a precipitation-hardening alloy steel commonly called A286, and 12 per cent chrome steel known as Type 410 stainless are now being used. The use of such materials permits the use of very thin-walled parts without sacrificing strength.

Fabrication problems are also considerable. Fabrication must be more precise. Distortion due to fabrication and heat-treating must be minimized. The use of fixtures for heat-treating is eliminated whenever possible. As new high-strength, high-temperature alloys are developed, the metallurgists and the shop must work very closely to develop new machining, fabricating, and heat-treating techniques.

Fixing tolerances is another of the problems encountered in the manufacture of smaller engines. The problem is discussed with reference to compressor blades, blade manufacture, electronic tracer controls which check blade contour, turbine diaphragms, and compressor disks.

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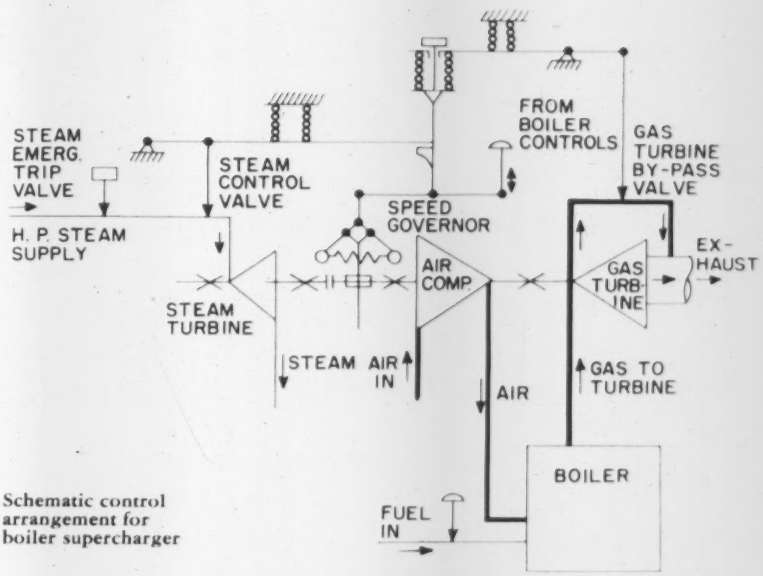
Design Features of a Gas Turbine for a Supercharged Boiler, by J. M. Baker, J. B. Gilbert, and W. B. Moyer, General Electric Company, Schenectady, N. Y. 1957 ASME Fall Meeting paper No. 57—F-31 (multilithographed; available to July 1, 1958).

A GAS-TURBINE boiler supercharger designed for the United States Navy by the General Electric Company is described in this paper. This gas-turbine boiler supercharger consists of an axial-flow compressor supplying high-pressure air to a pressurized boiler and a flow turbine deriving power from the expansion of the boiler exhaust gases to drive the compressor.

The supercharger set supplies pressurized air to a boiler with a 13-stage axial-flow compressor which is driven by a 2-stage flow turbine. Maximum compressor air flow is 205,000 lb-per-hr at 5.87 pressure ratio. Turbine power is derived from expansion of the boiler exhaust gas at maximum inlet temperature of 820 F. An auxiliary steam turbine supplies deficit power when the gas turbine is not self-sustaining and supplies additional power for acceleration from minimum to maximum air flow. A 10-horsepower motor starts the supercharger and the auxiliary steam turbine accelerates the supercharger to self-sustaining speed after the boiler starts generating steam. The supercharger design is described with reference to the requirements of this application.

Of particular interest in this application for possible shipboard use is the large reduction in weight and volume of the pressurized boiler in comparison with a conventional boiler. Reducing the boiler volume and weight permits increased fuel-carrying capacity for a given hull size. In order to fully realize this advantage, however, the supercharging gas turbine set must also be kept as small as possible. The supercharging set described herein is approximately one half the weight and the size of a commercial combustion gas turbine with a rating corresponding to the air flow of this supercharger. This reduction in size and weight has been made while still using normal gas-turbine and steam-turbine design practices regarding safety and reliability. There has been extensive use of fabrication to reduce weight, and some sacrifice of accessibility and peak efficiency levels has been made to further reduce weight and physical size of the supercharger.



Schematic control arrangement for boiler supercharger

Applied Mechanics

Bending Frequency of a Rotating Beam, by M. J. Schilhansl, Brown University, Providence, R. I. 1957 ASME Fall Meeting paper No. 57—F-6 (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1958).

THIS investigation on vibrations of a blade of an axial-flow turbomachine is a contribution to the so-called classical theory of natural frequencies of spring-mass systems, in which a time-wise variation of the forces exerted by the flow is not accounted for as it is in the flutter theory. It is restricted to the analysis of pure bending. This means that the shear center of each cross section is assumed to coincide with the center of gravity and that the torsional rigidity is very high.

The stiffening effect of the centrifugal forces on the first-mode bending frequency of a rotating cantilever beam of uniform cross section is investigated by means of the method of successive approximations. It depends upon the angle made by the minor axis of inertia with the direction of the circumferential velocity.

●

Force in the Plane of Two Joined Semi-Infinite Plates, by J. T. Frasier, The Pennsylvania State University, University Park, Pa., and Leif Rongved, Bell Telephone Laboratories, Inc., Murray Hill, N. J. 1957 ASME Fall Meeting paper No. 57—F-7 (in type; in the *Journal of Applied Mechanics,* December, 1957; available to July 1, 1958).

THE Papkovitch functions for a force at a point in the interior of one of two semi-infinite elastic solids joined across a plane boundary have been determined by Rongved.

Using a method introduced by Flamant, Rongved's solution is applied here to find the state of stress caused by a force parallel to the plane of two joined semi-infinite plates and which is operative at a point in one of the plates. The solution is given in closed form in terms of arbitrary values of the elastic constants of the two materials. The details of the solution are outlined and the results presented.

Torsion and Flexure of Slender Solid Sections, by W. J. Carter, Mem. ASME, The University of Texas, Austin, Texas. 1957 ASME Fall Meeting paper No. 57—F-4 (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1958).

THE solution of the torsion problem for a slender rectangular section has been made previously by approximate methods based on the Prandtl membrane analogy. In this paper approximate methods are employed in the solution of both the torsion and flexural shear problem for slender sections having a variety of shapes, most of them being doubly symmetric.

Solutions obtained in this manner are compared with exact solutions, when these are available, and otherwise with solutions obtained by relaxation. It is shown that approximate methods provide an adequate solution for elements such as compressor-turbine blades when pretwist and taper can be neglected. Some attention is given to the problem of elastic-plastic torsion and elastic-plastic flexural shear of slender sections.

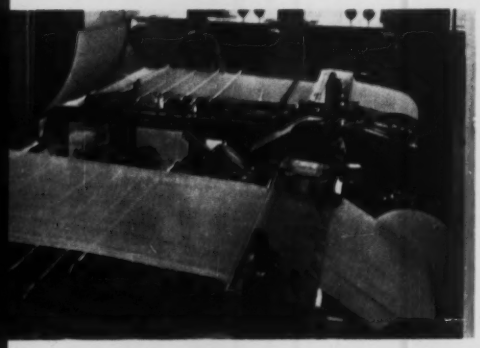
Machine Design

Modern Adjustable-Speed Drives for Textile Machinery, by A. T. Bacheler, Westinghouse Electric Corporation, Buffalo, N. Y. 1957 ASME Fall Meeting paper No. 57—F-23 (multilithographed; available to July 1, 1958).

THE adjustable-voltage d-c drive, in its simplest form, consists of a d-c shunt-wound motor excited at constant field and whose armature is energized from a separately excited constant-speed generator. The field excitation of the generator is adjusted to vary the generator voltage and, by this means, the motor speed.

This paper describes the basic features of the direct-current adjustable-voltage drive, including the characteristics of the constant-speed shunt-wound motor, the adjustable-speed motor, the compound-wound motor, and the series motor. Individual examples of the use of each type of motor are shown in applications to textile machinery.

The basic considerations of group drives of load sharing and synchronized types are discussed and illustrated by typical applications to bleaching and dyeing-range drives. Construction of packaged power and control equipment for textile applications is described.



Multicylinder slasher operating with one size box and a conventional head end, consisting of delivery rolls and beam take-up

Slasher installation with power and control units in background

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Power Drives for Warp-Preparation Machines, by George Manning, Cocker Machine and Foundry Company, Gastonia, N. C. 1957 ASME Fall Meeting paper No. 57—F-24 (multilithographed; available to July 1, 1958).

POWER drives for warp-preparation machines in the textile industry have been improved to give better tension control, simplicity of operation, reduced maintenance, and long service. A variety of power drives are available to fulfill almost any requirements. The selection of the proper drive is dependent upon a clear understanding of the yarns to be processed on a particular machine.

The fundamental requirement of a slasher drive in the processing of the actual yarn is to apply tension where it is required and to control this tension so as to dry, split out, and wind the warp of the loom beam.

Suggestions are presented for taking advantage of improvements in power drives for slashers and warpers, based on understanding of process requirements for yarn.

Discussion is limited to the drive requirements for a 9-cylinder slasher operating with one size box and a conventional head end, consisting of delivery rolls and beam take-up.

On a conventional multicylinder slasher, it is necessary for the slasher drive to control tension at these basic points: Between side box and cylinder section, between cylinder section and delivery rolls, and between delivery roll and the beam take-up.

On a modern slasher it is desirable to have complete control of the slasher speed at all times. This requires control of running speed, acceleration and deceleration, and creep speed.

Tensions throughout the slasher are discussed from creel to size box, size box to can section, dry cans to delivery roll, delivery rolls to the loom beam.

Three types of power drives which are available for slashers are considered: Cocker constant tension ac-dc friction drive; electric multimotor drive; and hydraulic multimotor drive.

In a discussion of power drives for warpers, spindle-driven warpers used in conjunction with an individual package creel are considered. The basic requirement for the drive is accurate speed control during beam build-up, quick stopping on yarn breakage, and smooth start-up. For the spindle-driven warper the ac-dc drive is most popular. It consists of a motor-generator set, d-c motor, and control.

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D-C Braking of A-C Motors in the Textile Industry, by J. C. Marous, Westinghouse Electric Corporation, Charlotte, N. C. 1957 ASME Fall Meeting paper No. 57—F-33 (multilithographed; available to July 1, 1958).

THE use of braking for stopping a-c textile motors has increased tremendously in recent years. This type of braking has been used on spinning frames, roving frames, cloth-inspection frames, warpers, lap winders, folders, twisters, and shearing machines. Actual field experience by many textile manufacturers has conclusively proved that d-c braking of a-c motors offers the following advantages:

1 A quick smooth stop assured at all times.

2 Constant degree of braking at all times—no periodic adjustments required.

3 Braking effect is easily adjusted over a wide range.

4 Maintenance cost and "downtime" greatly reduced over the old mechanical brake. No moving parts to wear or replace.

5 Eliminates "kinks" in yarn as well as "run-offs" when used on a spinning frame.

6 Reduces power consumption.

7 Saves valuable floor space.

8 Eliminates reversing of the motor.

9 Reduces heating in the motor as compared to plugging the motor to a stop.

10 Eliminates disturbing solenoid hum.

11 Requires no special double extended shaft motor.

●

A Numerical Method for Determining Cam-Follower Response, by H. A. Rothbart, Mem. ASME, The City College of New York, N. Y. 1957 ASME Fall Meeting paper No. 57—F-17 (multilithographed; available to July 1, 1958).

A TREND toward higher speeds, heavier loads, and greater accuracy in machines, has resulted in a need for determining the actual response of a cam-drive follower.

The shape of the cam curve may be given in any form: Graphically, analytically, or numerically. The numerical method described in this paper has been used successfully in practice, is simple to apply, and provides rapid analysis of the follower displacement, velocity, acceleration, and force curves. It also considers the fabrication accuracy of the cam contour. Furthermore, because of its fundamental approach the procedure

may be applied to any mechanism or combination of links; for example, quadric trains, gears, and chains, to determine the position of the members during high-speed and/or high-load operation.

The follower system is replaced by an equivalent spring and mass assuming a single degree of freedom. The method applies to all cam curves, measured or otherwise, and is rapid and accurate. If desired, it may include the effect of manufacturing inaccuracies of the cam contour. It should be noted that the fundamental approach indicated may be applied to any mechanism.

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Control of Steam-Jet Vacuum Pumps, by C. G. Blatchley, Mem. ASME, Schutte and Koerting Company, Cornwells Heights, Pa. 1957 ASME Fall Meeting paper No. 57—F-15 (multilithographed; available to July 1, 1958).

STEAM-JET vacuum pumps have been in use for many years, but few installations have required control of suction pressure. Increases in process application have included requirements for controlled conditions. In order to apply controls to ejectors properly, performance characteristics must be known. The ejector performance must be analyzed, and a method of control selected that will not cause discontinuities or instabilities in performance. When these factors are taken into account, ejectors are quite susceptible to control.

This paper discusses the various types of steam-jet vacuum pumps and their reaction to control systems.

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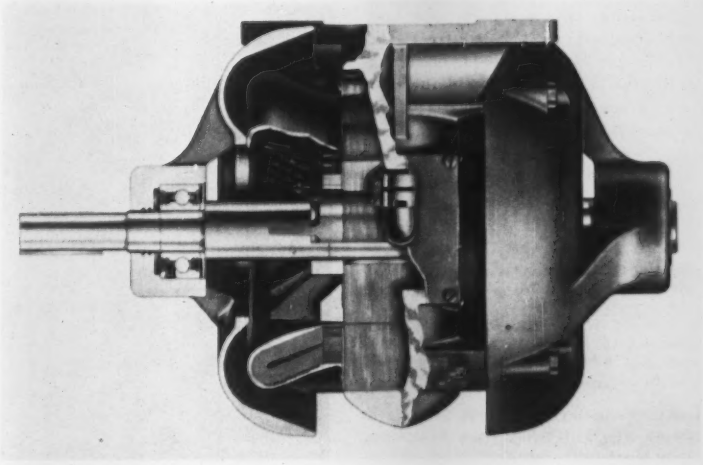
Proposed Standardized System for Notation and Classification of the Four-Bar Linkage, by B. L. Harding, Heald Machine Company, Worcester, Mass. 1957 ASME Fall Meeting paper No. 57—F-28 (multilithographed; available to July 1, 1958).

A SYSTEM of classification which enables a novice to perceive the characteristics of a four-bar linkage at a glance, is presented in this paper. A consistent system of notation is developed which permits the writing of general equations, and several other aspects of four-bar linkage nomenclature are standardized to promote better understanding and communication with regard to this subject. For soundness, the entire system has a mathematical basis, yet it is so simple that, in most cases, it can be applied merely by visual inspection of a given linkage. This system of notation and classification is proposed for adoption as a standard for formal discussion of the four-bar linkage.



Open lint-free motor in cross section. Motors of this type find frequent application in the textile industry.

Modern Textile Motors, by J. B. Wren, Westinghouse Electric Corporation, Buffalo, N. Y. 1957 ASME Fall Meeting paper No. 57—F-16 (multilithographed; available to July 1, 1958).

ELECTRIC motors are widely used in the textile industry. The use of a-c motors with emphasis on the mechanical features required in many textile-industry applications is the subject of this paper.

In general, every motor used in textiles must be capable of continued, successful operation in temperatures and humidities higher than normal with the additional hazard of lint. If the motors are open, the lint-laden cooling air must either pass through the motor without clogging the passages, or be screened of lint before entering the motor. If the motors are enclosed, fan-cooled types must allow the lint to pass through and the nonventilated motors must not be adversely affected by a build-up of lint on the outer surface.

There are numerous applications where some specific mechanical and/or electrical feature is required. A cotton card requires a motor with exceptionally high starting torque for its size. A roving frame requires an easy start in order not to break the delicate strands of yarn. Loom motors must be of rugged mechanical design to withstand the shocks imposed upon them. There are, however, many motor drives which, aside from being lint free, require no special electric design. Included in this group would be the opener, picker, lapper, comber, winders, spooler warpers, and so on.

Evolution of the present-day loom motor and the lint-free fan-cooled motor is described. The loom motor of waste-packed sleeve bearings has been replaced by the totally enclosed nonventilated motor with antifriction bearings. The open or screened textile motor is now beginning to be replaced by the totally enclosed fan-cooled motor in many applications.

Fuels

Sound Methods of Solid Fuel Evaluation for Use in Thermal Power Stations, by E. D. Holdup, Ontario Hydro-Electric Power Commission, Toronto, Ontario, Canada. 1957 ASME-AIME Joint Fuels Conference paper No. 57—FU-1 (multilithographed; available to August 1, 1958).

No two coals are identical. This paper discusses sound methods of evaluating the following classifications of natural fuels: Lignite, subbituminous, bituminous, and anthracite.

The physical characteristics of solid fuels are enumerated and each considered in detail. They include: Heat-energy content, moisture content, fixed-carbon content, ash content, ash-softening temperature, grindability, storability, burning characteristics, and the like.

The effects of different characteristics of solid fuel on boiler-plant design and operation problems are discussed in detail for the stoker-fired furnaces, pulverized-fuel-fired furnaces, and cyclone furnaces. Coal-purchase considerations are enumerated, giving the recommended bases for purchase price, weighing, sampling, and calorific-value determinations. Conditions for acceptance or rejection of delivered coal are recommended, together with price adjustments for variations in the calorific value, ash content, and moisture content of the

delivered coal different from the conditions specified in the contract. A final table sets out general recommendations for the selection of solid fuels for the three main types of furnace, for most suitable operation, although appreciable variation is possible at the price of lower efficiency and possibly lower availability.

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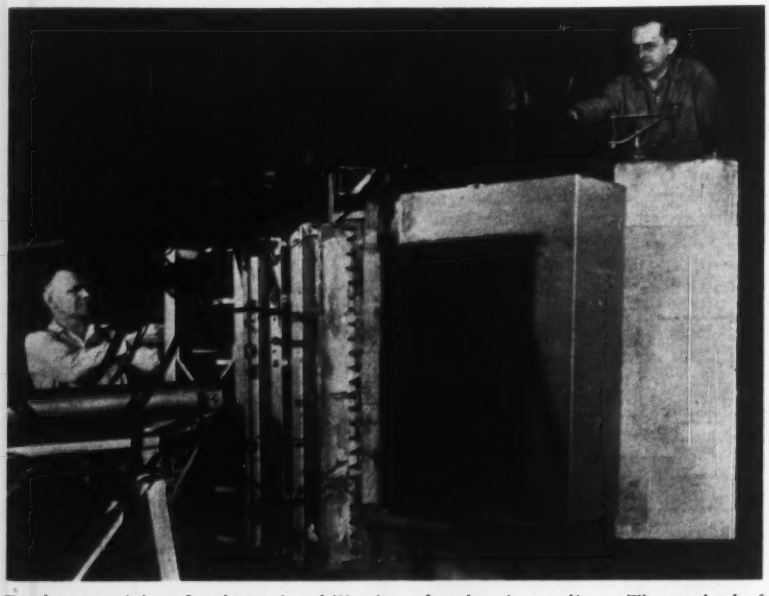
Thermal Stabilization of Anthracite by Calcination, by J. W. Eckerd and R. F. Tenney, Bureau of Mines, U. S. Department of Interior, Schuylkill Haven, Pa. 1957 ASME-AIME Joint Solid Fuels Conference paper No. **S7—FU-3** (multilithographed; available to August 1, 1958).

THE purpose of this paper is to describe two retorting processes that have been studied with the object of thermally stabilizing anthracite so that it can be used in modern metallurgical equipment. The first series of tests was conducted with a relatively low-volatile anthracite from the Eastern Middle field, and the second with a Western Middle field anthracite having relatively high volatile-matter content. The products of these tests have been analyzed and tested by standard procedures for metallurgical cokes and the results correlated with the conditions of the individual runs. These tests resulted in the anomaly that, in one instance, the anthracite was beneficiated with regard to resistance to impact and abrasion by the heat-treatments described, and in the other case it was not.

Use tests of the products in foundry cupolas also presented anomalous results. The materials from the first series of tests did not perform satisfactorily, while those from the second tests were satisfactory for the particular foundry conditions encountered.



Batch-type calciner for thermal stabilization of anthracite studies. The method of calcination consists of placing the anthracite in a sheet-steel retort in a movable-wall, expansion-type, coal-carbonization oven.

Petroleum

Reduced Pressure Drilling, by R. A. Bobo and G. S. Boudreaux, Phillips Petroleum Company, Houston, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-26** (multilithographed; available to July 1, 1958).

REDUCED pressure drilling may be defined with a circulating medium whose effective return column (annular) density is less than that of muds which are in common use. It may at the present time be broken down into two categories—air or gas drilling and aerated mud drilling.

Reduced pressure drilling has resulted in remarkable increases in penetration rates and bit footages.

The object of this paper is to show the results that have been achieved, the recent techniques and equipment that have been employed, and the method of application. A further object is to present the current limitatons of the separate phases of reduced pressure drilling, the problems that need to be overcome, and to outline those developments which are essential to insure the future success of this type of drilling in all applicable areas.

Advances in Diesel-Electric Rig Design for Oil Well Drilling, by B. H. Hefner, General Motors Corporation, LaGrange, Ill. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-36** (multilithographed; available to July 1, 1958).

OPERATIONAL experience with approximately 28 working rigs, accumulated over the three-year period since the first rig went into operation, has firmly established the soundness of design and construction of the Model SR-8 integrated diesel-electric power unit. It has successfully met the basic needs of the oil well drilling industry in virtually every type of deep-well field application. A program of continuous product development and improvement, however, has been carried on, and a new model developed. Designated SR-10, the new unit reflects design advances in major components as well as in minor refinements.

A review of the major new features of the SR-10 unit is presented. The new model represents evolutionary changes rather than revolutionary innovations. It should be noted too, that it is both possible and feasible to upgrade an operating SR-8 skid to an SR-10 with a significant saving over the purchase of a completely new unit. It is equally feasible to replace any one component with the new version found on the SR-10.

To briefly enumerate some of the advances made in the SR-10:

1 Greater engine, generator, and motor horsepower.

2 Fewer components.

3 Substantially less maintenance and easier maintenance for components requiring periodic servicing.

4 Completely independent power supply.

5 More flexibility in rig setup.

6 Improved performance in control and operation.

7 Completely self-contained, except for fuel and air supply.

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Designing Safe Installations for Inert Gas Machines, by C. H. Evans, Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-38** (multilithographed; available to July 1, 1958).

INERT-GAS machines which burn a fuel and air mixture to produce a gas of nitrogen and carbon dioxide, when

used in the petroleum and chemical industries have an increased potentiality for being involved in fires and explosions. Additional hazards, however, may be introduced depending upon the use for the inert gas and on the design of the storage and consuming systems. Sometimes in the petroleum and chemical industries, the interrelation of inert-gas producing hazards with gas-consuming hazards is not recognized fully.

The prevention of disasters resulting from interrelated hazards is the subject of this paper. An outline of one tentative proposal for safe design is presented. This proposal has not yet been operated in its entirety, but is under study with consideration of alternatives to attain the most practical design.

●

Requirements for Fabrication of Pressure Piping as Related to Service, by J. J. Murphy, Mem. ASME, C. R. Soderberg, Jr., Assoc. Mem. ASME, H. S. Blumberg, D. B. Rossheim, Mem. ASME, The M. W. Kellogg, New York, N. Y. 1957 ASME Petroleum Conference paper No. **57—PET-32** (multilithographed, available to July 1, 1958).

A REVIEW of current vessel and pressure equipment practices is presented in this paper which also analyzes the interrelation of materials, design, fabrication, and inspection with safety, economics, and service hazard for special application to pressure piping. These considerations lead to a proposal for a new broad "balanced" approach. The proposal is organized and presented as a summary tabulation of significant assumptions, criteria, and requirements, which have been correlated with four basic classes or qualities of piping. These are roughly established by the variables of mill product tolerances, applicable fabrication and inspection techniques, and the extent of quality control and nondestructive examination.

●

Instrumentation and Controls, Centralia Water Flood, Illinois, by K. M. Foster, Shell Oil Company, Centralia, Ill. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-30** (multilithographed, available to July 1, 1958).

WATER flooding is becoming a more and more important part of the oil industry. Water-flood production accounts for some 33 million barrels of oil annually in Illinois alone. The design, installation, and operation of such facilities require considerable expenditures. It is the engineer's task to employ instruments and controls to keep operational and maintenance costs at a minimum.

This paper discusses the application of instruments and controls to the Centralia Water Flood which consists of 112 producing and 97 injection wells. In this flood the application of controls was given serious consideration and wherever automatic devices could be justified they were designed and installed. This has resulted in the very efficient operation of a somewhat complicated water flood. Items of unusual nature include the centralized remote reading of several meters, remote tank gaging, automatic well testing, and remote operation of the pipeline pump station. Approximately 1000 individual pieces of instrumentation were installed. Operation of these controls and the flood in general has been satisfactory and oil production has increased from 230 to 5000 barrels per day in one year's time. The personnel necessary to operate this flood include: One plant operator 24 hr per day, two pumpers 8 hr per day, and one gagermeter reader 8 hr per day.

The source of water for the Centralia Water Flood is the Devonian limestone, at approximately 3000 ft. The water is produced, mainly, by deep-well submersible pumps using conventional switch gear.

A closed-type water-treating system is used to minimize oxygen entry into the water and subsequent corrosion and formation plugging problems. The water-treating plant is practically automatic in operation with the treating rate automatically adjusting to the injection rate. All equipment automatically shuts down when it reaches the limit of its variable range. With the exception of the inert-gas generators and the injection pumps, all automatically restart when conditions require.

Detailed discussion is given to flow control, flow measurement, water-quality control, inert-gas generators, injection pumps, and the injection system. Producing wells, automatic well testing, operations recording, and oil-handling facilities are also considered.

Engineering Design, Testing, and Operation of the Gilsonite Solids Pipeline, by R. K. Bond, Standard Oil Company of California, San Francisco, Calif. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-28** (multilithographed, available to July 1, 1958).

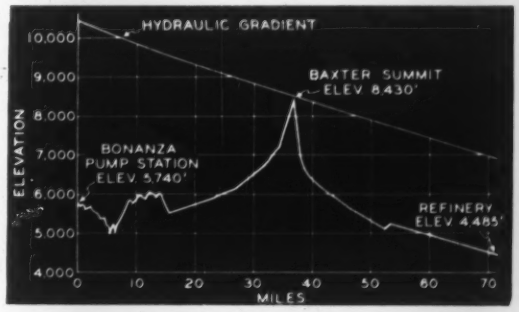
GILSONITE is a unique hydrocarbon mineral found as a raw material in the Uintah Basin of eastern Utah. It resembles hard black asphalt but is technically an asphaltite.

The first Gilsonite solids were transported 72 miles by pipeline as part of a $15-million refinery project. This project converts 700 tons per day of Gilsonite into gasoline, fuel oil, and high-grade metallurgical coke.

The pipeline crosses an 8500-ft mountain pass, and along most of its length the country is rugged and uninhabited. This pipeline has been engineered after careful analyses and extrapolation of results from small-scale tests. Tests were conducted on 500-ft loops of 4-in. and 6-in. pipe through which slurry was continuously circulated to determine flow characteristics of the suspended solids, pipeline corrosion, reduction in particle sizing due to hydraulic transport, and so on. These tests were conducted at the Colorado School of Mines' Research Foundation, Golden, Colo.

Additional testing was required to develop pumping equipment that would be capable of forcing slurry into the line at pressures over 2000 psi. Samples of pipeline effluent from the pilot pipeline tests were sent to equipment manufacturers throughout the United States and to Germany for testing various methods to dewater and reclaim the solids at the pipeline terminal.

Current operation of the pipeline is discussed in this paper in relation to pipeline hydraulics—pressure drop, minimum flow velocity, sand or other accumulation in pipelines, line capacity, maximum particle size, erosion and corrosion, and continuity of flow.



Profile and hydraulic gradient of Gilsonite slurry pipeline

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Management

Organize Your Engineering Project, by M. Tourtellotte, Assoc. Mem. ASME, Michigan Seamless Tube Company, South Lyon, Mich. 1957 ASME Fall Meeting paper No. 57—F-11 (multilithographed, available to July 1, 1958).

ORGANIZING the details of an engineering project saves valuable time for creative thinking. In the spring of 1953, Inland Steel Company approved an appropriation to engineer and construct a modest power-expansion project. The essential components in the project included a 200,000-lb-per-hr, 300-psig, 700-F steam generator complete with automatic combustion control and its supporting utilities; and a 10,000-kw, 7200-volt, 3-phase, 25-cycle condensing turbogenerator and its supporting utilities; and a substation with 10-ton overhead crane, switch gear, and 1000-kw motor-generator set.

The research and development, cost studies, and execution phases of the project are described. The elements of organization of the several phases are delineated. First among these is the need for maintenance of central records for correspondence, blueprints, purchase orders, and calculations. It is necessary also to keep all concerned well informed through frequent progress reports, lists of materials ordered and to be ordered, schedules of materials and services, and meetings. Distribution of the work load is also an essential element in the organizational scheme.

The results of this organized approach to an engineering project were the erection and operation of a $3^1/_2$ million power-expansion project within two months of the scheduled date of completion.

ASME Transactions

THE November, 1957, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

Experimental Investigation of Critical Design Factors for Vane-Type Cyclones, by A. B. Walker and W. H. Cole. (56—A-199)

Estimation of Temperature Patterns in Multiply-Shielded Systems, by J. G. Bartas and E. Mayer. (56—A-130)

Heat Transfer by Radiation From Flames, by R. A. Sherman. (56—A-111)

Rate of Temperature Change of Simple Shapes, by Victor Paschkis and J. W. Hlinka. (56—A-118)

Pressure Drop for Parallel Flow Through Rod Bundles, by B. W. Le Tourneau, R. E. Grimble, and J. E. Zerbe. (56—A-134)

Resistance Coefficients for Laminar and Turbulent Flow Through One-Half-Inch Valves and Fittings, by C. P. Kittredge and D. S. Rowley. (56—A-190)

Losses in Pipe and Fittings, by R. J. S. Pigott. (56—A-63)

Compensation of Steady-State Flow Forces in Spool-Type Hydraulic Valves, by R. N. Clark. (56—A-121)

Skewed Boundary-Layer Flow Near the End Walls of a Compressor Cascade, by R. W. Moore, Jr., and D. L. Richardson. (56—A-131)

An Investigation of the End-Wall Boundary Layer of a Turbine-Nozzle Cascade, by J. R. Turner. (56—A-132)

Jet-Pump Theory and Performance With Fluids of High Viscosity, by R. G. Cunningham. (56—A-58)

An Experimental Study of Centrifugal-Pump Impellers, by A. J. Acosta and R. D. Bowerman. (56—A-41)

Computer Representations of Engineering Systems Involving Fluid Transients, by F. D. Ezekiel and H. M. Paynter. (56—A-120)

Method for Presenting the Response of Temperature-Measuring Systems, by Robert Looney. (56—A-102)

Responses of Temperature-Sensing-Element Analogs, by G. A. Coon. (56—A-101)

Signal Stabilization of a Control System, by Rufus Oldenburger. (56—A-92)

Design Basis for Cascade-Type Positional Servomechanisms, by Sidney Lees and T. C. Blaschke. (56—A-105)

The Phase-Space Method for Analysis of Nonlinear Control Systems, by Y. H. Ku. (56—A-103)

Influence of Repeated Bending Loads on Biaxial Residual Stresses in Shot-Peened Plates, by T. M. Elsesser. (56—A-109)

The Flow and Fracture of Nodular Cast Iron, by W. R. Clough and M. E. Shank. (56—A-110)

Creep Characteristics of Type 347 Stainless Steel at 1050 and 1100 F in Tension and Compression, by M. J. Manjoine. (56—A-40)

Design and Development of a Two-Cycle Turbocharged Diesel Engine, by P. J. Louzecky. (56—A-100)

Future Developments of the High-Speed Diesel Engine, by Ernest Chatterton. (56—A-141)

Analysis of a Process-Fluid-Flow Network by Electric Analogy, by C. F. Kayan and J. A. Balmford. (56—A-187)

Electrical Effects Accompanying the Stick-Slip Phenomenon of Sliding of Metals on Plastics and Lubricated Surfaces, by G. W. Sohl, J. Gaynor, and S. M. Skinner. (56—A-163)

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Engineer's Working Relations Abroad

To the Editor:

I have read with interest the article[1] on this very touchy subject in the May issue, and would like to make the following comments.

The very source of the trouble lies in your attitude toward the whole matter: "work hard to help build up another country and help train foreign technicians." First, the author is undoubtedly perfectly sincere in his belief that American engineers who go abroad are motivated by a desire to help other people. However, the Americans who come to Venezuela make no bones about the fact that they have but one reason: money. This is a perfectly good motive but, when accompanied by the frequent laments of "I'd never stay here if it weren't for the money," it becomes a little hard to take, especially to those of us who have lived in the States and can contrast the standards of living enjoyed by these people here in comparison to what they could afford at home.

Secondly, it should be specified that the "training" consists of training us in the American method of doing things. We are already engineers, and good ones. Many of us have graduated from the best engineering schools in the States and yet in American companies are expected to work under American engineers from mediocre schools at much lower salaries than they enjoy. Naturally, this causes resentment.

The author's arguments in favor of the much higher salaries enjoyed by Americans do not convince us. It is true that the American engineer, when he goes abroad, leaves all that he is accustomed to. And there undoubtedly are posts that could be described as "hardship" posts. But in Caracas, for example, what justification is there for the tremendous difference between the "American payroll" and the "local payroll?" What the American is accustomed to is nothing in comparison to what he finds here. He is living in a beautiful, modern, and growing city; he is in a country whose money is as hard as the dollar; he can afford servants, belong to clubs, choose his friends from a very large American colony; he finds American schools, supermarkets, churches—all the comforts of home. His company helps him with the rent, his children's education, a cost of living bonus; he pays no Stateside taxes, and every two years he and all his family are sent home for a three months' vacation at company expense, over and above his "local leaves." Americans, as a people, do not spend all their lives in one spot. Could the average engineer in the States living in California, for example, afford to visit his parents in New England every two years for three months? And yet, despite all these advantages, it is still considered necessary to pay American personnel three times and more what the local engineering personnel earn.

I do not agree with the author's statement that Americans must be compensated for the contacts they are missing which would ordinarily lead them to better jobs in the future. On the contrary, the parent company at home, as well as people from competitive companies here, are very much aware of them and it is my belief that they have more of a chance to show what they can do in a relatively small plant abroad than when they are merely an infinitesimal part of a tremendous organization at home.

However, the main point, it seems to me, is not how much compensation Americans are entitled to—it is, how many Americans it is necessary to send abroad to begin with. No one would deny that Americans have a genius for organization. Why, then, do they not head up their foreign operations with a top-flight manager, and then hire good local people to work under him? It would eliminate the language barrier, avoid wasteful expenditure of the stockholders' money, and create good-will, which you claim you wish to do. Since it has not been tried, it cannot be claimed that it won't work. And since the local engineering companies, staffed by Latin and European personnel, are enjoying spectacular success and accomplishing worth-while projects, it cannot be claimed that only Americans can do a good engineering job. Fortunately, the Lord did not restrict the gift of intelligence solely for those of "God's country."

I would like to make clear that this is not a case of "sour grapes." I am lucky enough to be associated with a tremendously successful Venezuelan organization, because in this rich and fast-growing country, one is not forced to accept inferior jobs in American companies as is sometimes the case in poorer and less-developed places.

I think it is very significant that 99 per cent of the Americans down here are with American companies and not with local companies, which would seem to indicate that we do not need them as much as the author seems to think.

The investment of American capital has always been beneficial, and we are glad of the progress the establishment of industry brings. It is understood that if good profits were not to be made, there would be no incentive for investment in a foreign country. What is not understood, however, is the disinclination of American companies to give a fair chance to the natives of the countries in which they establish themselves.

Mauricio Casanova B.[2]

Author's Closure

The discussion by Mauricio Casanova Bazan is a welcome contribution and should be read carefully by everyone who is interested in the subject. He has clearly brought out some points which the author failed to stress, but at the same time he has not fully understood what

[1] "The Engineer's Working Relations Abroad," by C. P. Dunn, Mechanical Engineering, May, 1957, vol. 79, pp. 432 and 467.

[2] Mauricio Casanova Bazan, Assoc. Mem. ASME, Project Engineer, C. A. Venezolana de Pulpa y Papel. "Venepal," Apartado 2036, *for mail* Apartado 5326 Este, Caracas, Venezuela, S. A.

the author said, and actually he is in fairly close agreement.

We would stress these points:

1 In answer to the question: "Why, then do they (the Americans) not head up their foreign operations with a top-flight manager, and then hire good local people to work under him?" we can say that the firm with which the author is connected comes as nearly as may be practicable to doing exactly that. Some other firms do not follow that policy so diligently, but the practice is coming to be regarded by more and more firms as the only satisfactory answer.

2 In answer to the remark that "the 'training' consists of training us in the American method of doing things," we may say that the firm with which the author is connected has had occasion to learn, a number of times, that the "American way" is not always the best way under varying conditions and circumstances.

3 Finally, all of us, both Americans and people of other nations, must keep in mind the fact that the need for help or training, where a need exists, does not constitute a reflection on the ability of the people who need and want help. The situation is that where one group of people lack experience in a certain area of technical activity, and another group happen to have that experience, there is no reflection on anyone if the two groups arrange to work together on a mutually profitable basis.

C. P. Dunn.[3]

[3] President, International Engineering Company, Inc., San Francisco, Calif.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Resources in the Next Hundred Years

THE NEXT HUNDRED YEARS: A discussion prepared for leaders of American industry. With a preface by Lee A. DuBridge. By Harrison Brown, James Bonner, and John Weir. Viking Press, New York, N. Y., 1957. Cloth, 5¾ × 9¼ in., figs., notes, bibliography, index, xi and 193 pp., $3.95.

Reviewed by George A. Stetson[1]

THE authors of this book are, respectively, a geochemist, a biologist, and a psychologist, all of the California Institute of Technology. Their text is based on discussions of a group of fellow faculty members, under the leadership of Robert V. Bartz, director of the Industrial Associates program at that institution and, later, of a group of corporate executives.

The text begins with the posing of such questions as: "What is the future of our industrial civilization likely to be? Can we foresee the major problems that will confront us? Are these problems soluble? What kind of a society could one science and one technology help us to create in a world at peace?" The answers are developed by taking the long view of man's natural and technological resources. The practicability of this attempt to forecast the next hundred years is justified by the authors' belief that "the destiny of the human species is being determined in large part by the action and inactions of those of us who are alive today."

[1] Editor Emeritus, ASME. Fellow ASME.

After presenting some of the startling contrasts throughout the world today (in the United States, the United Kingdom, USSR, Japan, and India, for example) in per capita calorie intake and production, fertilizer applied, birth and death rates, national income, newsprint consumption, coal production, petroleum consumption, electricity consumption, steel production, and motor vehicles and telephones per 1000 persons, the authors remind us that the 7000-year-old agricultural revolution which changed a food-gathering into an agrarian society is now being superseded by the industrial revolution which requires quantities of raw materials and sources of energy.

"To what degree," the authors ask, "can we expect the longevity of industrial civilization and the extent to which it spreads to be limited by the availability of these raw materials?" Answers to this question depend upon "increasing per capita demands for raw materials," "the rate of spread of industrial civilization," "how large the population of human beings is likely to become," and "the amounts of raw materials available to man." As to the last point, the authors state that "our concept of a raw material has constantly broadened," and hence continued expansion of available raw materials "will depend upon the rate with which new knowledge can be accumulated and applied. And this in turn will depend upon the extent to which we are able to develop our human-resource potential."

A résumé of the increasing demands made on raw materials and power by the progress of industrialization, particularly in the United States where its benefits in material welfare are most abundantly apparent, leads the authors to estimates of the needs of the world when population may have been stabilized at about seven billion persons (contrasted with 2.6 billion at present) and the standards of living of the two billion now living at extremely low levels of consumption approach those in more fortunate areas. Needless to say, the quantities of food, raw materials, energy, and scientific and engineering manpower become prodigious. Although the problems involved are complex and numerous, the authors do not despair of its accomplishment.

Eventually the solution comes down to education and the increase and best use of brain power. The text ends with the following paragraph:

"We have seen that, in principle, man can, if he wills it, create a world where people can lead lives of abundance and creativity within the framework of a free society. It is apparent that there will be many difficulties; there will be many dangers. But it seems reasonably clear what man must do in order that the path may be negotiated. It remains to be seen whether he will recognize these

problems in time to proceed to create a still higher level of integration, or whether he will permit his civilization at its present stage to disintegrate, perhaps, never to reappear. The future of industrial society revolves around the question of whether man can learn to live with man."

The book under review is easy reading, even if the problems it raises are complex and difficult. Anyone with a high-school education should be able to understand what the authors have to say and follow their logic. The more intelligent will find it a source of inspiration and hope, and will be kindled with a desire to play his part in the task that lies ahead. The scientist and the engineer will comprehend more thoroughly the intense degree of specialization which must be developed in science and technology if these desirable aims are to be met.

The responsible citizen, regardless of his vocation, will find a challenge to face in bringing educational levels up to those which are indicated. Those who ask for facts will find them in abundance and on good authority. It should encourage and give a sense of purpose and direction to the man, to use Oliver Cromwell's phrase "that knows what he fights for and loves what he knows."

Engineers particularly should find this book interesting and stimulating. And they will be pleased to note that in practically every instance the authors have used the terms "science and engineering" or "scientists and engineers." These are, after all, the men who will bear the heaviest responsibilities in the next hundred years.

Industrial Management in Australia

AUSTRALIA AND THE CHALLENGE OF CHANGE: being a study of the second industrial revolution and its possible effects upon Australia. By Walter Scott. The Law Book Co. of Australasia Pty. Ltd., Sydney, Melbourne, Brisbane, Australia, 1957. Cloth, $5^3/_4 \times 9^1/_2$ in., index, xviii and 540 pp., 75/-.

Reviewed by Lillian M. Gilbreth[1]

THIS book, written by a management consultant in Australia, is primarily for Australians. But it is not only a fine, careful piece of work, full of valuable information, but one that can be most useful to American readers.

Part 1, "The Direction of Change," occupies two thirds of the book. Most of the material was obtained from American books, periodicals, and newspapers—as the author points out. The wide and discriminating reading and the pithy and stimulating comments are amazing in a person who leads the busy and demanding life of the top-flight consultant of his Country, responsible for a large, active organization.

The purpose of this part of the book is to bring to the Australian reader material which he is not likely to get otherwise. But an American reader finds it a profitable experience to study this; first, as well-organized information and, second, as it gives one an opportunity to see how the author has evaluated what he has read.

The second part of the book "—And Australia," while, like the first, written for Australians, is the consideration of the ideas presented in part 1. It does not repeat, but in an orderly way, sets forth the problem Australia faces and the types of answers that present themselves. The reader not only gets a clear picture of the Country, but of its resources, material and human. We see likenesses to and differences from us. We are given facts and figures to substantiate what is said. Best of all, we are stimulated to think!

The method of presenting the material is interesting. The short preface presents the need for such a book, its purpose, and its desire to share information that will make clearer thinking for Australians possible.

Each chapter of the 39 is headed by two quotations, which help to set the tone of the presentation. The topical headings group the material so that the reader is helped to follow the development of the thought. The many references are numbered in the text and given at the end of each chapter.

In part 2, each chapter has a set of numbered conclusions. This makes it easy to review the points made. The last chapter, "Operation Australia," defends the emphasis put on the "problems" and the "challenges" the title of the book indicates.

As the "acknowledgments" that open the book indicate, it is a "team work" project, the author's family having helped on it. This—to those who know the Scotts—is no surprise, for the name of the organization is W. D. Scott, Ltd., the D. standing for Dorothy, Mrs. Scott. This reflects the author's attitude toward women all through the book—as students of science and engineering and as managers.

The dedication is to Sir John Storey, which reflects the sense of obligation his Country felt to this great industrialist who was not only a leader but a warm friendly person—proud of his Country, and welcoming to it friend and stranger in typical Australian manner.

This review may make the book sound heavy and difficult to read. It is not. The author's interest in the subject he discusses—his desire to share his thinking with people, his sense of humor, and light touch enliven the 540 pages. It is to be hoped that this book will receive a wide reading in the United States not only by management people, but by the many who want to know of Australia and of the type of thinking as to the future going on there and here in the U. S. A.—and in many other countries of the world.

A gift copy is in the Engineering Societies Library to be read there by anyone and borrowed by any Member, living anywhere. Copies are obtainable from The Carswell Company, 145-149 Adelaide Street West, Toronto 1, Canada, priced at $9.75, postpaid.

Once read, a copy will be added to one's reference shelf to be consulted often, with renewed pleasure.

[1] President, Gilbreth, Inc., Montclair, N. J. Hon. Mem. ASME.

Books Received in Library

ASTM STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS. Published 1956 by the American Society for Testing Materials, Philadelphia, Pa. 1066 p., 6 × 9 in., paper. $6.75. Of the 180 standard and tentative methods of test and specifications contained in the current edition of this annual compilation, 48 are completely new or revised. Some of the new test methods are for tetraethyllead in gasoline, evaporation loss of lubricating greases and oils, mercaptan sulfur in jet fuels, and analysis of calcium and barium petroleum sulfonates.

ANALOG COMPUTERS: THEIR INDUSTRIAL APPLICATIONS. Proceedings of a Symposium, April, 1956, Sponsored and published by the Midwest Research Institute, Kansas City, Mo. 210 p., $8^1/_2 \times 11$ in., paper. $5. Eleven papers and a round-table discussion devoted to the use of computers for the design and operation of engineering systems; flood routing and other hydraulic problems; economic programming; industrial control problems; and other technical and nontechnical problems.

ANALYSIS FOR PRODUCTION MANAGEMENT. By Edward G. Bowman and Robert B. Fetter. 1957, Richard D. Irwin, Inc., Homewood, Ill. 503 p., $6 \times 9^1/_4$ in., bound. $7.80. This text for the university student and the interested industrialist provides an analytical approach to economic problems of production management. The methods of analysis potentially useful in making economic decisions mostly involve mathematics and are organized in four major groups: orientation, mathematical pro-

gramming, statistical analysis, and economic analysis. The authors, both assistant professors of the School of Industrial Management at the Massachusetts Institute of Technology, use many examples including cases drawn from real situations as illustrations.

APPLIED ANALYSIS. By Cornelius Lanczos. 1956, Prentice-Hall, Inc., Englewood Cliffs, N. J. 539 p., $5^1/_2 \times 8^3/_8$ in., bound. $9. The purpose of this book is to cover the area between "pure" and strictly "applied" mathematics by presenting the analysis and design of finite processes which rapidly approximate the solution of an analytical problem. This handling of the major mathematical tools so as to minimize the error in a relatively small number of steps is of primary concern to the engineer and physicist who can thereby make use of them.

BIBLIOGRAPHY ON INDUSTRIAL RADIOLOGY, 1954-1956. By Herbert R. Isenburger. 1957, St. John X-Ray Laboratory, Califon, N. J. 21 p., $9 \times 11^1/_2$ in., binder. $3. This sixth supplement to the second edition of "Industrial Radiology," 1942, brings the coverage of radiology literature up to 1956. Books, pamphlets, government contract research, patents and articles from foreign as well as American periodicals are listed.

COMPANY INVESTIGATIONS OF AUTOMATIC DATA PROCESSING. By Peter B. Laubach. 1957, Division of Research, Harvard Business School, Soldiers Field, Boston, Mass. 258 p., $5^1/_4 \times 8^1/_8$ in., paper. $3. Intended as an aid to management personnel interested in the use of computers for business data, this book describes briefly computer components and programming, presents case histories of company evaluations of data-processing methods, and considers in detail the steps to be taken in investigating the practicability of a data-processing system. Chapters on cost and savings estimates and on the selection of equipment are included.

ESSAIS DE LABORATOIRE ET COMPORTEMENT EN SERVICE DES MÉTAUX. Symposium organized by the Ministère de L'Éducation Nationale with the co-operation of the Société Française de Métallurgie, Paris, 1955. Published by Éditions Métaux, St.-Germain-en-Laye, France. 173 p., $8^1/_4 \times 10^1/_2$ in., paper. Fr frcs. 2,000. This symposium on the physics of metals covers a considerable variety of topics: dislocations and plastic qualities of solids; behavior of metals under complex strains; fatigue of airplane structures, and of machine elements; mechanical, metallurgical, and electrochemical factors in corrosion; mechanism of oxidation of metals at high temperatures; and laboratory tests of railway rolling stock.

THE FINAL FORMING AND SHAPING OF WROUGHT NON-FERROUS METALS. Published 1956 as Monograph and Report Series No. 20 by The Institute of Metals, London, England. 128 p., $8^1/_2 \times 11^1/_2$ in., bound. 21s. This published record of a symposium held by the Institute of Metals in London, in April, 1956, consists of eight papers, a general discussion, and indexes by names and subjects. The papers deal with machining properties; deep drawing and spinning of sheet metal; rubber pressing; cold roll forming of light-gage sections; stretch forming; bending and allied operations; and the hot forming of magnesium alloys. The papers are reprints from the Journal of the Institute.

FLÄCHENTRAGWERKE. By Karl Girkmann. Fourth Edition, 1956, Springer-Verlag, Vienna, Austria. 596 p., $6 \times 9^1/_4$ in., bound. $15.70. A detailed treatment of the elastostatics of plate structures, which discusses the important problems involved in the calculations of stresses and deflections in plates, shells, and prismatic structures. For practical use the analytical solution of a wide range of such problems is carried out, with particular attention to the underlying principles. An extensive list of references accompanies each of the five main sections.

Library Services

ENGINEERING SOCIETIES LIBRARY books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

GRAPHICS FOR ENGINEERS. By Warren J. Luzadder. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 597 p., $6 \times 9^1/_4$ in., bound. $8.65. A book on engineering drawing which covers the fundamentals, but in which the emphasis is on engineering geometry, multiview representation, basic descriptive geometry, and freehand sketching, with particular attention to perspective pictorials and graphical methods for solving engineering problems. The purpose is to develop the ability to visualize spatial conditions and to use graphical forms of representation as a means of communication. There is a special chapter on graphs, charts, and nomograms.

HEAT AND THERMODYNAMICS. By Mark W. Zemansky. Fourth Edition, 1957. McGraw-Hill Book Company, Inc., New York, N. Y. 484 p., $6 \times 9^1/_4$ in., bound. $7.50. The first ten chapters of this textbook are concerned with the basic concepts of temperature, thermodynamic systems, work, heat transfer, reversibility and entropy, with applications mostly to ideal gases. The remaining nine chapters deal with physical, chemical, and engineering applications in greater detail. Such modern applications of thermodynamics as second-order phase transitions, the Giauque temperature scale, the Onsager method of treating irreversible coupled flows and its application to a thermocouple, dielectric phenomena, and the physics of low temperature are included.

LEXIQUE TECHNIQUE. (Français-Anglais, Anglais-Français) by Guy Malgorn. 1956, Gauthier Villars, Paris, France. 2 volumes, $5^1/_4 \times 8^1/_4$ in., paper. $7.06 each volume. This standard English-French technical dictionary, in its fourth edition, now has a companion French-English volume. It covers the whole field of technology: construction work of all kinds, machines and machine-shop practice, electrical engineering and electronics shipbuilding, mining, metallurgy, petroleum, transportation, etc. Different meanings are given for various contexts, and numerous examples of phrases and combinations are given for many words. General words are not included except in specific applications.

MECHANICAL ENGINEERING LABORATORY INSTRUMENTATION AND ITS APPLICATION. By Jesse S. Doolittle. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 396 p., $6 \times 9^1/_4$ in., bound. $6.50. The author makes a distinction between part 1 which is devoted to the subject of instrumentation and part 3 which deals with the applications of instrumentation to typical engineering problems. Part 2, determination of selected physical and chemical properties of fuels and lubricants, introduces the engineer to some of the tests developed by ASTM and ASME for obtaining qualitative evaluation of many complex physical properties which cannot be measured directly. Although intended for the first courses in mechanical engineering, it is designed to give necessary background for all laboratory courses in this field.

MECHANICAL ENGINEERING LABORATORY PRACTICE. By Edgar E. Ambrosius and Robert D. Fellows. 1957, The Ronald Press Company, New York, N. Y. 539 p., $6 \times 9^1/_4$ in. bound. $7. This textbook covering the general field of mechanical engineering is divided into three parts. Part 1, principles of mechanical engineering, deals with laboratory philosophy, techniques of laboratory procedure, and the writing of the engineering report. Part 2 is devoted to the discussion of laboratory instruments while part 3 includes laboratory exercises. The appendix contains useful tables giving conversion factors, properties of common substances, properties of steam, etc.

MESSUNG MECHANISCHER SCHWINGUNGEN. VDI-Fachgruppe Schwingungstechnik. Richtlinien VDI 205-210 (October, 1956). 1956, Verein Deutscher Ingenieure, Düsseldorf, Germany. 190 p., $8^1/_4 \times 11^6/_8$ in., paper. DM 52.50. A guide to the effective measurement of mechanical vibration developed by a special committee of the VDI. Vibration types and systems are classified and briefly described, followed by sections on measuring apparatus and methods, vibration exciters for test purposes, and balancing equipment. Much of the information is in tabular form for quick reference. These recommendations are the result of a literature survey of more than 600 references covering buildings, bridges, masts, foundations, machinery of all kinds, motor vehicles, ships, and airplanes.

NATIONAL TURBINE-POWERED AIR TRANSPORTATION MEETING. Proceedings of the Third Meeting, San Diego, Calif., August, 1956. Sponsored and published by the Institute of the Aeronautical Sciences, New York, N. Y. 114 p., $8^1/_2 \times 10^7/_8$ in., paper. $6. Seventeen papers devoted to various problems associated with the introduction of turbine and jet aircraft into commercial airline service. Among the problems considered are operation, maintenance, pilot training, community reaction to jet aircraft noise, noise and airport planning, and structural failure due to jets.

THE PLASTIC METHODS OF STRUCTURAL ANALYSIS. By B. G. Neal. 1956, John Wiley & Sons, Inc., New York, N. Y. 353 p., $5^1/_2 \times 8^3/_4$ in., bound. $7.50. The first part of this book, intended for practicing structural engineers and research workers, is concerned with a presentation of the plastic methods of analysis which have been developed for calculating plastic collapse loads for frames with the ultimate objective of establishing rational and economical design procedure. The last part deals with closely associated topics, such as estimates of deflections; factors affecting the fully plastic moment; minimum weight design; and variable repeated loading. There are examples to illustrate each chapter. The appendixes contain proofs of theorems, such as the proof of the shake-down theorem.

WATER FOR INDUSTRY. Edited by J. B. Graham and M. F. Burrill. Published 1956 by the American Association for the Advancement of Science (Publication No. 45), Washington, D. C. 131 p., $5^{7}/_{8} \times 9^{1}/_{4}$ in., bound. $3.75. Nine papers presented at a symposium held at the AAAS Boston meeting in 1953, to focus attention on the importance of the water problem to both national security and internal economic stability. The papers deal with water supply and water requirements; the geographic distribution of industry; waste treatment and disposal in the atomic energy industry, and water-pollution abatement. Two of the papers deal with specific cases: water supply at the Fairless Works and the restoration of the Schuylkill River.

WISSENSCHAFLICHEN GESELLSCHAFT FÜR LUFTFAHRT, JAHRBUCH, 1955. Published 1956 by Friedr. Vieweg and Son, Braunschweig, Germany. 360 p., $8 \times 11^{3}/_{4}$ in., bound. DM 48. Some 40 papers are presented dealing with a wide range of subjects in the aviation field: aerodynamics, flight-control systems, performance characteristics of airplanes, airplane structures, meteorological problems, engine research, etc. A few of the papers are in English and English summaries are provided in all cases.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting, Sept. 13, 1957, and approved by the Board on Nov. 5, 1957.)

Case No. 1181-2

(Reopened)
(Interpretation of Par. P-112(c))

Inquiry: Par. P-112(c) makes stress-relief of carbon and carbon-molybdenum steel mandatory in thicknesses appreciably less than those currently permitted under other sections of the Code. May these thicknesses and carbon content of the carbon-molybdenum materials be increased? Under what circumstances may stress-relief be omitted on chromium-molybdenum steels?

Reply: It is the opinion of the Committee that under Par. P-112(c) the following need not be stress-relieved:

(1) Carbon steel in thicknesses less than $^{3}/_{4}$ in.

(2) Carbon-molybdenum steel with carbon not exceeding 0.25 per cent in thicknesses less than $^{1}/_{2}$ in.

(3) Chromium-molybdenum steels with a maximum specified chromium content of 3 per cent and a maximum outside diameter of 4 in. and a maximum thickness of less than $^{1}/_{2}$ in. Circumferential joints in the pipe or tubes of the "P" No. 4 steels shall be preheated to 250 F min. and the "P" No. 5 steels shall be preheated to 300 F min.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

AS NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Low-Pressure Heating Boilers, 1957

PAR. H-1(4)(a) Revise to increase the heat input from "100,000 Btu per hr" to "200,000 Btu per hr."

Unfired Pressure Vessels, 1956

PAR. U-1(d)(3)(a) Revise to increase the heat input from "100,000 Btu per hr" to "200,000 Btu per hr."

PAR. UG-84(b)(3) Revise to read:

For several vessels or parts of vessels being welded in succession, the plate thickness of which does not vary by more than $^{1}/_{4}$ in., and of the same grade of material, a test plate subject to the requirements of (1) shall be furnished for each 200 feet of longitudinal and circumferential welded joints.

PAR. UG-99(a) Revise third line to read:

"... of Pars. UG-100 or UG-101, ..."

PAR. UG-99(b) Revise to read:

Except as otherwise permitted in (a) and (k), vessels designed for internal pressure shall be subjected to a hydrostatic test pressure which at every point in the vessel is at least equal to one and one-half times the maximum design pressure to be marked on the vessel multiplied by the lowest ratio (for the materials of which the vessel is constructed) of the stress value S for the test temperature on the vessel to the stress value S for the design temperature (see Par. UG-21). All loadings that may exist during this test shall be given consideration.

PAR. UG-99(c) Revise to read:

A hydrostatic test pressure of at least $1^{1}/_{2}$ times the maximum allowable pressure as defined in Par. UA-60(e) may be used if agreed on by the user, the manufacturer and the inspector. The hydrostatic test pressure at the top of the vessels shall be the minimum of the test pressures calculated for each pressure element reduced by the hydrostatic head on that element. When this test pressure is used, the inspector shall reserve the right to require the manufacturer or designer to furnish the calculations used in determining the hydrostatic test pressure for any part of the vessel.

PAR. UG-99(d) Revise to read:

The requirements of (b) represent the minimum standard hydrostatic test pressure required by the Code. The requirements of (c) represent a special test based on calculations. Any intermediate value of pressure may be used. This Section of the Code does not specify an upper limit for hydrostatic test pressure. However, if the hydrostatic test pressure is allowed to exceed, either intentionally or accidentally, the value determined as prescribed in (c) to the degree that the vessel is subjected to

visible permanent distortion, the inspector shall reserve the right to reject the vessel.

PAR. UG-99(e) Revise to read:
Same as 1956 Par. UG-99(d).

PAR. UG-99(k) Delete (k) in 1956 Code and substitute the wording of Par. (1) of the 1956 Code except change the words "allowable working" to read "design."

PAR. UG-99(l) Revise to read:
Same as (m) in 1956 Code.

PAR. UG-100(a)(2) Change the last two lines to read:
". . . hydrostatic pressure to the pressure required in Par. UG-99."

PAR. UG-100(b) Revise to read:
Except for enameled vessels, for which the pneumatic test pressure shall be at least equal to, but need not exceed, the maximum design pressure to be marked on the vessel, the pneumatic test pressure shall be at least equal to 1.25 times the maximum design pressure to be stamped on the vessel multiplied by the lowest ratio (for the materials of which the vessel is constructed) of the stress value S for the test temperature of the vessel to the stress value S for the design temperature. (See Par. UG-21.) In no case shall the pneumatic test pressure exceed 1.25 times the maximum allowable pressure as defined in Par. UA-60(e).

PAR. UG-100(c) Revise to read:
The pressure in the vessel shall be gradually increased to not more than one-half of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Then the pressure shall be reduced to a value equal to $^4/_5$ of the test pressure and held for a sufficient time to permit inspection of the vessel.

PAR. UG-100 Note 2 Change second and third sentences to read:
For such vessels a combined hydrostatic and pneumatic test may be used as an alternative to the pneumatic test of this paragraph, provided the liquid level is set so that the maximum stress including the stress produced by pneumatic pressure at any point in the vessel (usually near the bottom) or in the support attachments, does not exceed 1.5 times the allowable stress value of the material multiplied by the applicable joint efficiency. After setting the liquid level to meet this condition, the test is conducted as prescribed in (b) and (c).

PAR. UG-101(e) In the fifth line revise to read:
". . . be given a hydrostatic test at a pressure . . ."

PAR. UW-50(c) Change "allowable pressure" to "design pressure to be marked on the vessel" in Line 6 and Note 2.

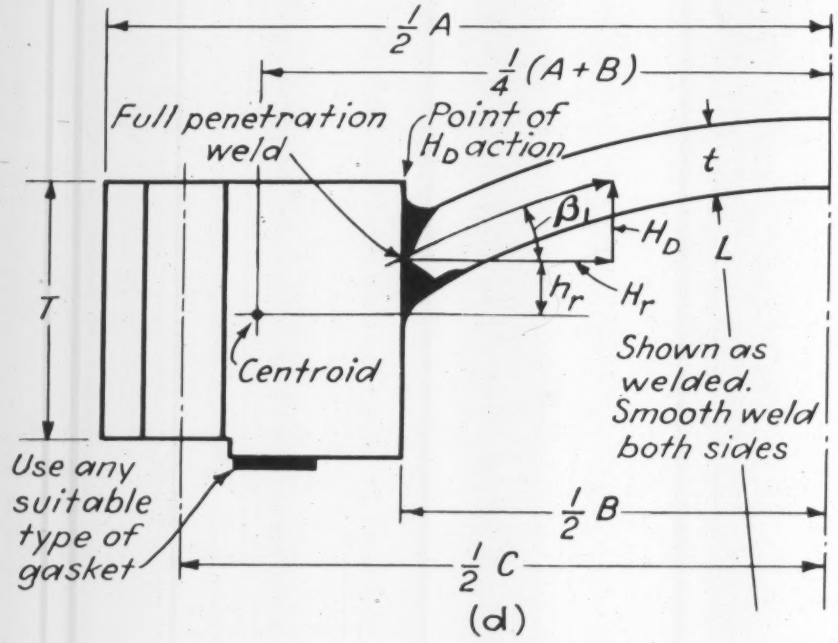
PAR. UCS-57 Revise to add:
. . . SA-225, SA-299, SA-301, SA-302 and SA-387, Grades A, B, and C at which the plate thickness. . . .

PAR. UCI-99 Change "design working pressure" to "maximum design pressure to be marked on the vessel."

FIG. UA-(6)(d) Replace with revised sketch shown on this page.

PAR. UA-60(e) Revise to read:
The highest internal pressure permissible in a vessel, as determined by the design formulas for the nominal thicknesses of all parts to be considered, and which may be used as the basis for determining the test pressure at test temperature (see Par. UG-99(c)). In the calculations for the maximum allowable pressure, the nominal thickness (including allowances for corrosion) of each vessel element such as head, shell, nozzle, bolted flange connection, reinforcements, shall be used, together with the allowable stress value given in Subsection C for the temperature of the vessel during the test.

PAR. UCN-3 Add the following clause to the Note:
. . . except that the $3^1/_2$ in. and smaller screwed and lapped flanges conforming in dimensions to the 125 lb. ASA Standard B16.1-1948, for cast iron flanged fittings shall have identical ratings specified in ASA Standard B16.1-1948.

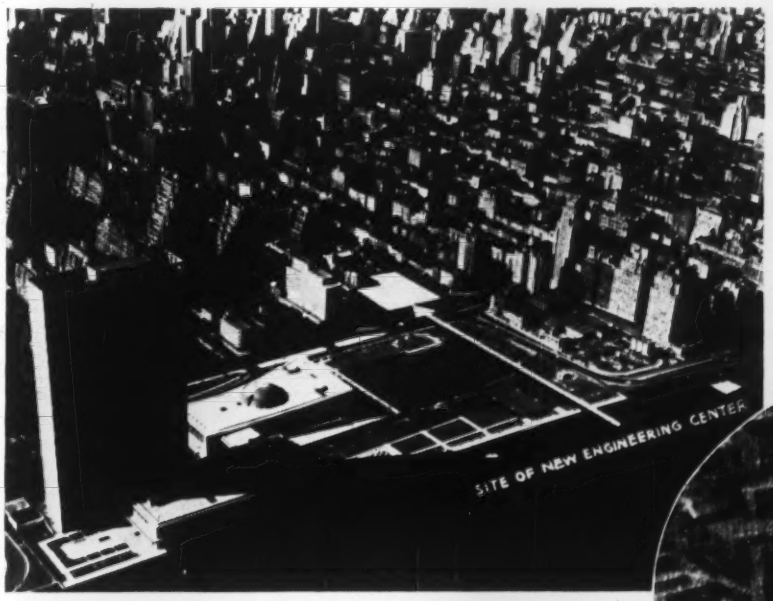


Revised detail (d) of Fig. UA-6 spherically dished steel-plate covers with bolting flanges

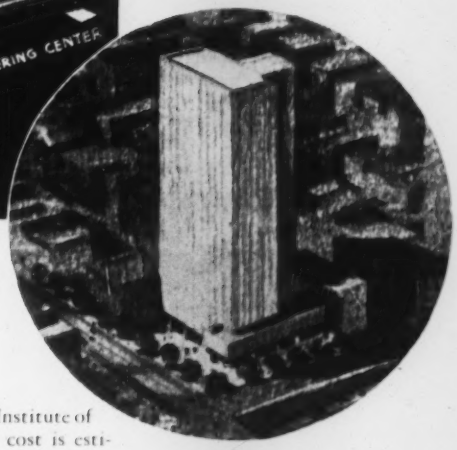
Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*



New Engineering Center. Aerial view of Manhattan highlights the site to be occupied by the new Engineering Center. Located diagonally across the street from the United Nation's Security Council Building, the Center will have a view across the East River and up and down United Nations Plaza. The imposing building designed as the Center for the Founder Societies and several societies with interests in allied fields will be situated on 47th Street—an impressive avenue being prepared as the official entrance to the United Nations.



United Engineering Center: Action on Building Fund

THE new United Engineering Center will be erected on United Nations Plaza between 47th and 48th Streets in New York City.

Designed to symbolize the dignity and achievements of the engineering profession, the Center will provide national headquarters for the continued advancement of engineering and technology. Not only will adequate facilities be provided for performing present functions, but sufficient provision will be made for continuing growth of services to the engineering profession.

The project is sponsored by the five "Founder Societies": The American Society of Civil Engineers, the American Institute of Mining, Metallurgical, and Petroleum Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Chemical Engineers. Total cost is estimated at $10 million. The five societies have undertaken to raise $3 million through member subscriptions.

Symbol of Engineering

The new Center, designed by Shreve, Lamb & Harmon Associates, will be a 20-story tower with lower structures at its base, and with landscaped surroundings. It will be attractive without being ornate, and will embody dignity without implying pretension.

In addition to space requirements for the societies, the Center will house the Engineering Societies Library. With Russia emerging as a tremendous center of technical publication, it is more than ever vital that our own engineering library have space to expand. Since it was established, 50 years ago, the library has grown until it contains 175,000 volumes, 20,000 maps, 5000 translations, 10,000 bibliographies and indexes, and 1500 current periodicals; and all this is made useful to engineers by an experienced staff. Photoprints and microfilms of library material are furnished, and books are loaned to members of the Founder Societies in the United States and Canada.

Today, the library is straining its obsolete facilities. For the 1956-1957 year, the staff responded to 41,881 requests—56 per cent of library use was by mail, telephone, and telegraph—sent out 74,000 photoprints, and translated some 450,000

. . . ASME's 44,000 members asked to subscribe—new 20-story building, on United Nations Plaza, will be national headquarters for ASME and other engineering societies . . .

words of technical literature. In the new building, facilities will be the most efficient in modern library practice.

Enlarged publication facilities are included in the plans, promoting information exchange, a field in which the Russians are now believed to be ahead of us. Private dining rooms for engineers attending meetings are planned, as well as a cafeteria.

An exhibition space is included in which the rapid advances in engineering will be interpreted for the general public. And, in keeping with the traditions and dignity of a proud profession a memorial hall is being considered, by which to perpetuate the contributions of great engineers to the effectiveness of American civilization.

The center will serve the Founder Societies and a number of associated organizations, and will permit expansion for all foreseeable needs for the next half century.

Role of the ASME

W. F. Ryan, who this month steps down from the Presidency of the ASME, will serve as chairman for the ASME in the drive to fulfill this Society's quota of the building fund. For those who wish to apply their contributions against taxes for the year 1957, checks may be sent now to United Engineering Trustees, Inc., at 29 West 39th Street, New York 18, N. Y. Contributions are deductible.

The five Founder Societies, with their member-gift goal of $3 million, total over 179,000 members. Adding student members and the memberships of associated organizations, the new Center will serve more than 280,000 engineers.

On June 29, 1957, United Engineering Trustees, Inc., announced the purchase of the site (MECHANICAL ENGINEERING, August, 1957). There could scarcely be a more desirable site in New York. Being in the vicinity of Manhattan's newest and finest buildings, its east and south windows will face the United Nations. It is a short distance from Grand Central Station and the East Side Airlines Terminal.

On Aug. 30, 1957, W. J. Barrett, president of United Engineering Trustees, announced the appointment of C. E. Davies as Building Co-ordinator for the new Center. Mr. Davies retires this month as Secretary of the ASME, a post he has held for 23 years. As Co-ordinator, he will maintain an office in the old Engineering Societies Building at 29 West 39th Street.

W. F. Thompson, Fellow ASME, chairman of Real Estate Committee of United Engineering Trustees, Inc., *left*, expresses appreciation to Mayor Robert F. Wagner of the City of New York, for the assistance rendered in securing the site for the new United Engineering Center on United Nations Plaza between 47th and 48th streets. Looking on is Commissioner Vincent J. O'Shea of the city's Department of Commerce and Public Events.

Coming Meetings

Molecular Physics

"MOLECULAR Physics in Chemical Engineering" is the subject of a symposium to be conducted January 2 and 3, 1958, at the Case Institute of Technology, Cleveland, Ohio. The symposium, sponsored by the Industrial and Engineering Chemistry Division of the American Chemical Society, will be divided into three sessions: Statistical thermodynamics, kinetic theory, and molecular structure. Outstanding scholars in the fields of physics, chemistry, chemical engineering, mechanical engineering, and aeronautical engineering will present papers.

Reliability and Quality Control

THE fourth National Symposium on Reliability and Quality Control will be held January 6-8, 1958, at the Hotel Statler, Washington, D. C.

Reliability organization and management, theory and mathematical techniques, application of these techniques, design information, and education and training for reliability will be the subjects of the symposium. Special emphasis will be placed upon reliability in the electronics industry.

For further details of the program, contact: Richard M. Jacobs, RCA Building, 108-2, Moorestown, N. J.

College-Industry Conference

INDUSTRY's needs for and utilization of well-educated and motivated technical personnel and the forced changes occurring in education as a result of pressures from industry and population growth are the main topics of a conference to be held January 30 and 31, 1958.

The 1958 College-Industry Conference of the Relations with Industry Division of the American Society of Engineering Education will be held at the University of Michigan, Ann Arbor, Mich.

Help Build the New Engineering Center

MEMBERS may contribute immediately to the building fund. Here is the answer to the question of tax refunds:

"Contributions made to you are deductible by the donors in computing their taxable net income in the manner and to the extent provided by section 170 (*b*) (1) and (2) of the 1954 code."—Letter from U. S. Treasury Department, Internal Revenue Service, to United Engineering Trustees, Inc., dated Aug. 14, 1957.

Checks should be made out to United Engineering Trustees, Inc., and mailed to them at 29 West 39th Street, New York 18, N. Y.

People

Honors and Awards. ANDREW PINKERTON, Mem. ASME, was presented with the Sixty-Five Year Award of the ASME, at his home in Alhambra, Calif.

GEORGE SACHS, Mem. ASME, professor of metallurgical engineering and associate director, Syracuse University Research Institute, was recently honored by two German societies. The Academy of Technical Sciences awarded him the Gauss Medal. He received the Heyn Medal from the German Society of Metals.

R. U. BLASER, Mem. ASME, and J. J. OWENS received the 27th Charles B. Dudley Medal. The award was presented at the annual meeting of the American Society for Testing Materials. This award is presented annually for a paper of outstanding merit constituting an original contribution on research in engineering materials.

WALTER RAMBERG, Mem. ASME, and L. K. IRWIN, Assoc. Mem. ASME, National Bureau of Standards, Washington, D. C., received the Richard L. Templin Award of the American Society for Testing Materials for their paper describing new and useful testing procedures and apparatus.

RONALD JAMES ROCKWELL was awarded the 1957 Marston Medal. The medal is awarded annually in memory of the late DEAN ANSON MARSTON of the Division of Engineering of the Iowa State College, Ames, Iowa.

WILLIAM HENRY LESSER, Assoc. Mem. ASME, received a citation from the Lehigh University Alumni Association in recognition of his pioneering as a mechanical-electrical engineer.

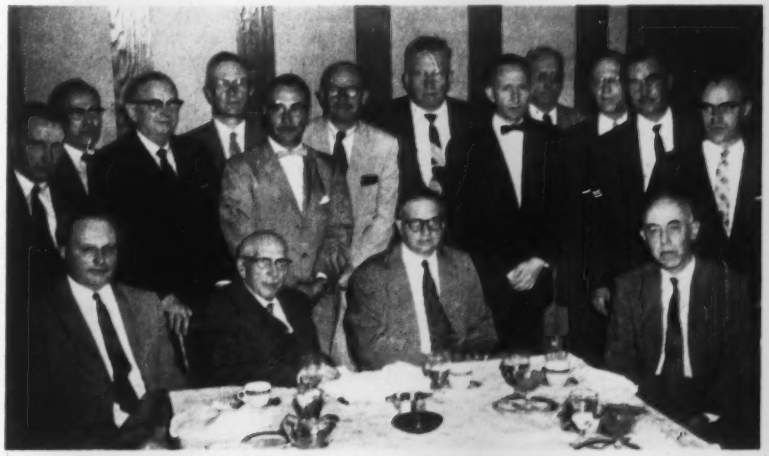
Four pioneers in the respective fields of electric furnaces, refractories, gas burners, and protective atmospheres, received the Trinks Industrial Heating Award, highest honor in the industry, at a banquet at the Duquesne Club, Pittsburgh, Pa., May 15. The four honored were: SAMUEL ARNOLD, 3RD, consulting engineer, Pittsburgh, Pa.; H. M. CHRISTMAN, vice-president and technical director, Massillon Refractories Company, Massillon, Ohio; W. BARTON EDDISON, Fellow ASME, consulting engineer, Ardsley-on-Hudson, N. Y.; and ALLEN G. HOTCHKISS, manager of furnace engineering, General Electric Company, Shelbyville, Ind. The Award, bestowed by a judges' panel of industrial heating authorities, is named after WILLIBALD TRINKS, Fellow ASME, professor emeritus of Carnegie Institute of Technology, a member of the panel, and world authority on industrial heating.

A. G. L. MCNAUGHTON, Hon. Mem. ASME, and Canadian chairman, Canada-U. S. Permanent Joint Board on Defense, and chairman, Canadian Section, International Joint Commission of Ottawa, received honorary membership in the Engineering Institute of Canada. The presentation of the awards, the highest honor paid by the Institute, was made during the annual meeting of The Engineering Institute of Canada.

R. J. S. PIGOTT, past president and Fellow ASME, consulting engineer, Pittsburgh, Pa., was among three recipients of the Elliott Cresson Medals. The award was presented by The Franklin Institute at its 31st Annual Medal Day ceremonies. Mr. Pigott was honored "In consideration of his engineering accomplishments, including his many valuable inventions, his painstaking research, his notable contributions to the technical press, and his engineering leadership." Others to receive the medal were: W. F. LIBBY, commissioner, U. S. Atomic Energy Commission, and SIR ROBERT A. WATSON-WATT, radiophysicist, Toronto, Ont., Canada.

DONALD A. QUARLES, Deputy Secretary of Defense, has been selected as the 1957 recipient of the American Institute of Consulting Engineers Award of Merit.

The award, citing Mr. Quarles as an "able administrator and noted scientist," was presented by EDWARD H. ANSON, president of the Institute, at the Institute's annual dinner, October 15, at the Hotel Waldorf-Astoria, New York, N. Y.



S. Logan Kerr, Fellow ASME, and consulting engineer, is honored at a luncheon at the Commodore Hotel, New York, N. Y. A citation, approved by Council and signed by ASME President Ryan and Secretary Davies, was presented to him in commemoration of his 25 years of service as Chairman of the Water Hammer Committee of the Hydraulic Division. In attendance at the luncheon were: Standing, *Left to right,* G. F. Wislicenus, L. J. Hooper, F. E. Jaski, H. S. Van Patter, B. L. Vanderboegh, G. D. Johnson, W. J. Rheingans, J. B. Holt, E. B. Strowger, W. R. MacNamee, G. H. Voaden, W. G. Whippen. Seated, *left to right,* C. W. Hubbard, E. E. Halmos, S. L. Kerr, R. S. Quick. Mr. Kerr, along with E. B. Strowger, E. E. Halmos, and R. S. Quick, was among the founders of the Water Hammer Committee.

E. H. Anson, *left*, president, American Institute of Consulting Engineers, presents its award of merit to Donald A. Quarles, Deputy Secretary of Defense, at their annual dinner held in New York City, October 15

JOSEPH C. ELGIN, dean of the school of engineering, Princeton University, Princeton, N. J., is the recipient of the 1957 William H. Walker Award. The award presented by the American Institute of Chemical Engineers is given annually to encourage writing on chemical engineering.

ELMER W. ENGSTROM, senior executive vice-president, RCA, New York, N. Y., will receive the 1958 medal of the Industrial Research Institute.

JAMES H. SAMS, Mem. ASME, and dean, college of engineering, Clemson Agricultural College, Clemson, S. C., has received the Distinguished Service Certificate of the National Council of State Boards of Engineering Examiners. The award was made by the NCSBEE at its annual meeting on October 31 to November 2, 1957, Atlanta, Ga.

RALPH D. WEBB, Mem. ASME, head of the instrument department, Union Carbide and Carbon Chemicals Corporation, has been made an honorary member of the Instrument Society of America in recognition of outstanding contribution to the art and science of instrumentation and automatic control.

WILLIAM L. EVERITT, dean of the college of engineering, University of Illinois, has been awarded the American Institute of Electrical Engineers' Medal in Electrical Engineering Education for outstanding service as a teacher. The award was presented at ceremonies opening the five-day Fall General Meeting of the AIEE at Chicago, Ill., October 7.

Campus Data. CHARLES R. MISCHKE has been appointed professor and head of the department of mechanical engineering of the Pratt Institute Engineering School. Dr. Mischke, who assumes this responsible post at 30 years of age, has a varied background in science.

FERDINAND P. BEER has been appointed head of the department of mechanics, Lehigh University, Bethlehem, Pa. The establishment of a curriculum in engineering mechanics started this September was approved by the faculty last December and by the university's board of trustees at its Spring meeting.

PAUL R. TRUMPLER, Mem. ASME, professor of mechanical engineering in charge of machine design at the Illinois Institute of Technology, Chicago, has been elected director of the School of Mechanical Engineering at the University of Pennsylvania. He succeeds LEE N. GULICK, Mem. ASME, who continues to serve the University as a professor of mechanical engineering and as a senior research engineer in the University's Institute of Co-operative Research.

HARVEY BROOKS, Gordon McKay professor of applied physics, Harvard University, became dean of engineering and applied physics at Harvard University on September 1. He succeeds Dean JOHN H. VAN VLECK, who plans to resume his research in mathematical physics.

JAMES E. BOYD, noted Georgia Tech physicist and research administrator, has been appointed director of the engineering experiment station at the Georgia Institute of Technology.

EDWIN DAVIES HARRISON, Mem. ASME, dean of engineering, University of Toledo, has been named president of the Georgia Institute of Technology, Atlanta, Ga. He assumed his duties on Aug. 15, 1957, succeeding the late COL. BLAKE VAN LEER, Fellow ASME.

EDWARD SAIBEL, Mem. ASME, Carnegie Institute of Technology, and WILLIAM H. HOPPMANN, 2nd, Mem. ASME, The Johns Hopkins University, have joined the faculty in mechanics at the Rensselaer Polytechnic Institute. Each assumed the rank of visiting professor at the opening of the college year.

PAUL E. HEMKE, Mem. ASME, as a result of recent action of the board of trustees of Rensselaer Polytechnic Institute, was appointed vice-president and provost. The following appointments were announced also by the board: CLAYTON O. DOHRENWEND, Mem. ASME, dean of the graduate school and acting dean of science; GEORGE H. LEE, Mem. ASME, director of the research division; and V. LAWRENCE PARSEGIAN, Mem. ASME, dean of engineering.

ERNST WEBER has been appointed acting president of the Polytechnic Institute of Brooklyn. He succeeds the late HARRY S. ROGERS, Mem. ASME, who died on June 6.

ROBERT F. OXNAM, vice-president for administrative affairs at Boston University since 1953, and also associate professor of government at the University, has been named president of Pratt Institute, Brooklyn, N. Y. Announcement was made by RICHARDSON PRATT, chairman of the board of trustees of the Institute. Dr. Oxnam, a resident of Newton, Mass., assumed his new duties in the beginning of October, 1957.

LOUIS N. ROWLEY, Fellow ASME, editor and publisher of *Power*, a McGraw-Hill publication, has been elected alumni trustee to the Corporation of the Polytechnic Institute of Brooklyn for a three-year term.

RALPH G. NEVINS, Assoc. Mem. ASME, has been appointed head of the depart-

ment of mechanical engineering, Kansas State College. M. A. Durlandru, Mem. ASME, dean of the school of engineering and architecture, announced the appointment. Dr. Nevins succeeds Linn Helander, Fellow ASME, who had been head of the department since 1935.

New Officers. C. Russell Mahaney, vice-president and director, St. Regis Paper Company, and general manager of its Panelyte Division, New York, N. Y., was elected president of the Society of the Plastics Industry, Inc. He will hold office for two years.

Walter J. Barrett has been elected president of the American Institute of Electrical Engineers for the year 1957–1958. Announcement was made at the Institute's annual meeting in the Sheraton Mount Royal Hotel, Montreal, Quebec, Canada.

Louis R. Howson, Mem. ASME, Alvord, Burdick and Howson, consulting engineers, Chicago, Ill., has been elected president of the American Society of Civil Engineers. Waldo G. Bowman, editor, *Engineering News-Record*, New York, N. Y., and Samuel B. Morris, consulting engineer, Los Angeles, Calif., were elected vice-presidents.

The American Management Association announced in New York, N. Y., September 19, the election of five new vice-presidents and eleven new directors. The new vice-presidents chosen to head the Association's operating divisions for the 1957–1958 term are as follows: Insurance, Frazier Wilson, United Air Lines; international management, A. L. Nickerson, Socony Mobile Oil Company, Inc.; manufacturing, M. C. Weaver, The Randall Company; marketing, T. T. Miller, W. R. Grace and Company. K. S. McHugh, New York Telephone Company, was elected a vice-president at large.

Robert J. Jeffries, Mem. ASME, Daystrom Inc., Murray Hill, N. J., was elected president of the Instrument Society of America at the society's annual meeting in Cleveland, Ohio. Henry C. Frost, Corn Products Refining Company, Chicago, Ill., is the new president-elect-secretary. Others to be elected vice-presidents are: Philip A. Sprague, The Hays Corporation, Michigan City, Ind.; Ralph H. Tripp, Grumman Aircraft Engineering Corporation, Bethpage, N. Y.; Carl W. Gram, Jr., Worthington Corporation, Harrison, N. J.; John T. Elder, Assoc. Mem. ASME, Tennessee Eastman Corporation, Kingston, Tenn.; Gordon D. Carnegie, King Instrument Company, Cleveland, Ohio; John F. Draffen, Monsanto Chemical Company, Texas City, Tex.; and Adelbert Carpenter, Fischer and Porter, Oakland, Calif.

Thomas A. Bissell has been appointed executive secretary of the Society of Plastics Engineers, Inc., effective Nov. 15, 1957. The announcement was made by Peter W. Simmons, SPE national president.

Research. Warren E. Snyder, Assoc. Mem. ASME, has been appointed manager of the Engineering Division of the Midwest Research Institute, Kansas City, Mo. Dr. Snyder is an authority on gas turbines with experience in general compressor aerodynamics and nuclear powered gas-turbine plants. The appointment was announced by Max H. Thornton, vice-president and director of the Institute.

Appointments. Robert K. Lockwood, has been transferred from the post of executive editor of *Civil Engineering* to a position as assistant to the executive secretary of the American Society of Civil Engineers. In his new position Mr. Lockwood will be responsible for co-ordinating the society's activities in the department of conditions of practice now being handled by assistant secretary, E. L. Chandler.

Hal W. Hunt has been appointed executive editor of *Civil Engineering*. As executive editor Mr. Hunt will work closely with Walter E. Jessup, editor of The American Society of Civil Engineers' official publication.

Burgess H. Jennings, Fellow ASME, Evanston, Ill., has been appointed director of research for the American Society of Heating and Air-Conditioning Engineers.

R. E. Peterson, Fellow ASME, was appointed to a three-year term as a director of the American Society for Testing Materials.

L. I. Dana has been appointed vice-president in charge of research and development of Linde Company, Division of Union Carbide Corporation. David Swan also received a new appointment as director of research.

Alex G. Oblad has been appointed a vice-president in charge of research and development activities at The M. W. Kellogg Company, a subsidiary of Pullman Incorporated, New York, N. Y.

The first Gantt Citation, established to recognize distinguished achievement in management services, was presented by John Handy, *right*, chairman, Gantt Medal Award Committee, to David Burr Porter, Fellow ASME, and professor emeritus of industrial engineering at New York University, "in recognition of his long services as an inspired teacher and leader in the field of management, and as an innovator and developer of new teaching techniques in management, and in the practice of management and advisory services." The presentation was made at a dinner in his honor, held on October 29.

American Standards Association Holds First Pacific Coast Standards Conference

BREAKING with precedent, the American Standards Association held its first conference on the Pacific Coast at San Francisco, Calif., November 13-15, 1957. The Eighth National Conference on Standards was held in conjunction with the 39th Annual Meeting of the ASA. Eleven sessions dealt with the development and use of standards for government and industry.

A panel discussion on that topic, a session on "Standardization in Your Company," and on "Cost Improvement Through Standardization," as well as "Partnerships in Standardization: Purchasing, Engineering, and Design," were followed by sessions which dealt with the application of standards to specific industries.

The Association of American Railroads sponsored one on "Profiting by Standards in the Railroad Industry," from the standpoint of purchasing, maintenance, and over-all economic effect. The Construction Specifications Institute sponsored a session on the "Value of Standards in Construction Specifications," with a panel representing a specification consultant, general contractor, the State of California Division of Architecture, an estimator, and a building code official.

The Motion Picture Research Council and the Society of Motion Picture and Television Engineers sponsored a session on "How Standards Help the Motion Picture Industry," with speakers on the motion picture testing film program, and proposed standards for "Videotape" transmission as well as on the general theme.

"Industrial Standardization for Defense," sponsored by the American Ordnance Association, considered special problems in that area. Speaking of the value of standardized measurements for compatible components, W. J. Darmody emphasized that "dimensional tolerance" has a much different meaning today than it did in the days of the micrometer, vernier, or mechanical amplifying measuring devices. Modern electronic or pneumatic amplifying devices are capable of being calibrated up to one millionth of an inch, and tomorrow's increasingly precise products will run only if they have been based on standard measures referred to at each stage of development.

Military standard drafting practice, the difficulty of getting standardization in the military electronics industry, and the improved standardization and profits to be obtained in the process industries were also considered in that session. Cyril P. Atkinson stated that "the logical extension of our industrial system culminates in an automatic plant, and automation will require a minor revolution in standards." Dimensional systems and nomenclature are being standardized to serve as a guide in the co-ordination of equipment design, component design, and the design of machinery for automatic manufacture. Printed circuits for electronic units are already being manufactured in accordance with an established standard.

The control, through standards, of exposure from ionizing radiation not only in industry but from radioactive wastes and deposits, was the subject of a session sponsored by the American Society of Safety Engineers.

At the Annual Award Dinner, the Standards Medal was presented to John R. Townsend, and the Howard Coonley Medal was received by Roger E. Gay. ASA president H. Thomas Hallowell, Jr., who had delivered the keynote address at the opening session, also presided at the dinner.

Prince Philip Honors Double Celebration

Dean Pegram Receives First Compton Medal—AIP Dedicates New Headquarters in New York

PRINCE PHILIP, on behalf of the Governing Board of the American Institute of Physics, conferred the first Karl Taylor Compton Gold Medal of the Institute on Dr. George Braxton Pegram, Fellow ASME, vice-president emeritus of Columbia University, and one of America's pioneer nuclear physicists.

The ceremony took place in conjunction with the dedication of the Institute's new building on East 45th Street near the United Nations. The award was presented before a group of distinguished scientists, educators, and administrators in the Karl Taylor Compton Memorial Room of the Institute.

In a brief speech, the Prince conveyed the "fraternal greeting" of all scientists in the British Commonwealth to the scientists of America.

"I believe there is no body of people to whom man-made barriers mean so little as they do to scientists the world over," the Prince said.

He remarked that he had had "some experience in receiving gold medals in this country," but that he had never previously presented one.

Dean Pegram received a congratulatory message from President Eisenhower, which read in part:

"As the first recipient of the Karl Taylor Compton Gold Medal, Dr. Pegram personifies the highest standards of scholarship, character, and service. His distinguished career has brought strength to your society and his confident plans will forever be an inspiration to those who use this new building. Moreover, I have a personal gratification because of the deep friendship I have felt toward Dr. Pegram ever since I first met him at Columbia."

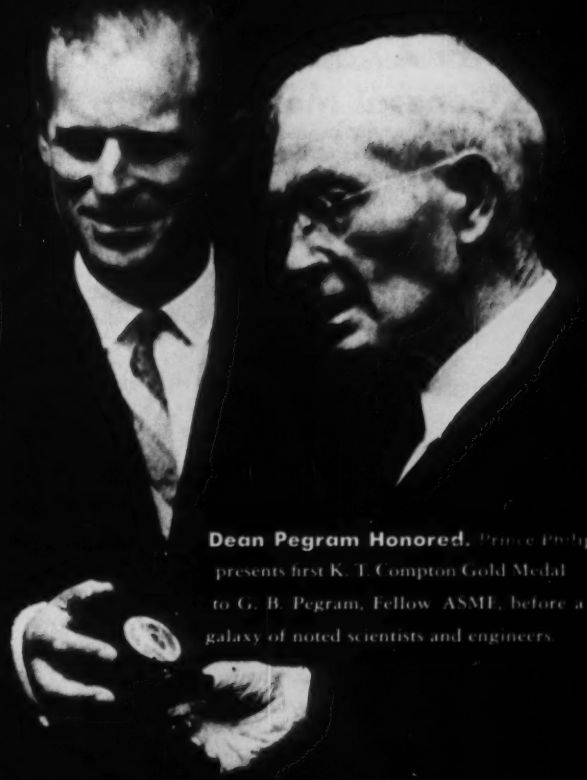
Dr. Compton, a leading figure in the nation's scientific war effort during World War II, died in 1954.

Following the ceremony, the Prince stayed to meet many members of the audience who included three Nobel-Prize winners in physics, Dr. I. I. Rabi and Dr. Polykarp Kusch of Columbia University, and Dr. Walter H. Brattain of the Bell Telephone Laboratories, as well as officers of scientific societies and friends of physics from various parts of the Nation.

The Prince had been introduced upon his arrival by Dr. Frederick Seitz, chairman of the Institute's governing board and chairman of the Department of Physics at the University of Illinois. Dr. Seitz also presided at the ceremonies and described the work of AIP.

The institute, a federation of five professional societies, publishes all of the principal American technical journals of physics and also engages in a variety of other programs designed at advancing the science of physics and improving the quality and quantity of physicists.

The purpose and program of the Institute were outlined in some detail by Dr. Elmer Hutchisson, director. Dr. Henry A. Barton, associate director, delivered a citation concerning the accomplishments of Dr. Pegram. The Compton Gold Medal was awarded for "distinguished service to physics."



Dean Pegram Honored. Prince Philip presents first K. T. Compton Gold Medal to G. B. Pegram, Fellow ASME, before a galaxy of noted scientists and engineers.

1 Dr. I. I. Rabi, Nobel Prize Winner of Columbia University, chats with Dr. A. T. Waterman, director of the National Science Foundation.

2 Dr. W. M. Compton greets Dean Pegram. Mrs. Karl T. Compton, seated at Dean Pegram's left, attends the double celebration, dedication of American Institute of Physics Headquarters and first presentation of Compton Medal.

3 Dr. George R. Harrison, vice-president, Massachusetts Institute of Technology, addresses meeting on "Karl Taylor Compton and American Physics."

4 Scientists and engineers hurry to the Compton Room. Registering is Dr. Waterman. Others shown include W. E. Kock, K. R. Darrow, C. E. Davies, secretary, ASME, and Lee DuBridge.

5 Dr. H. A. Barton, associate director, AIP, gives talk on Dean Pegram's work in behalf of American physics. Seen at head table are Dr. Frederick Seitz of University of Illinois, and chairman, AIP Governing Board, and Prince Philip.

Sperry Award for 1957 Goes to General Motors Group

Eugene W. Kettering, *right,* director of research, Electro-Motive Division, General Motors, is one of the winners of the 1957 Sperry Award. *Center;* R. B. Lea, a director of Sperry Products, Inc., and chairman of the Sperry Award Board. *At the left* is Mr. Kettering's father, the famed "Boss Ket" of General Motors. The senior Kettering has been a member of ASME for more than 40 years.

Development of the diesel-electric locomotive was commemorated on Oct. 10, 1957, at Chicago, Ill., with the presentation of the 1957 Elmer A. Sperry Award to members of the Electro-Motive Division of General Motors. Recipients were three early leaders in the development, plus all members of four sections of the engineering department of the Division.

The ceremonies took place at a luncheon in the Morrison Hotel, as part of the annual Fall General Meeting of the AIEE, and marked the first time a major American engineering honor has been conferred upon a group.

The Sperry Board of Award, composed of two representatives each of The American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society of Automotive Engineers, and Society of Naval Architects and Marine Engineers, conferred the award with the citation: "For development of the diesel-electric locomotive which helped revolutionize American railroading."

Those honored were: H. L. Hamilton, of Los Altos, Calif., retired vice-president of General Motors, and founder of Electro-Motive; R. M. Dilworth, of Hinsdale, Ill., retired, who was chief engineer of Electro-Motive from 1926 to 1951; and E. W. Kettering, also of Hinsdale, now director of research of the Division. Honors also went to the Electrical Engineering Section, represented by B. B. Brownell, Electro-Motive's chief engineer; Mechanical Engineering Section, represented by L. O. Parker, now a supervisor in the section; Locomotive Section, represented by Ludvig Petersen, chief structural engineer; and Controls Section, represented by T. O. Lil'quist, electrical research engineer.

The awards were presented by R. B. Lea, Life Mem. ASME, a director of Sperry Products, Inc., of Danbury, Conn., and chairman of the Sperry Board of Award, and by E. H. Anson, representing the AIEE. Other members of the Award Board are: W. N. Zippler, AIEE, J. C. Hunsaker and William Littlewood, SAE, and H. L. Seward and C. R. Waller, SNAME, and D. W. R. Morgan, past-president of the ASME. C. E. Davies, secretary of the ASME, is secretary of the Sperry Award Board.

The Sperry Award was instituted and first presented in 1955 to commemorate the achievements of Dr. E. A. Sperry, especially in the field of transportation. It may be given each year for a "distinguished engineering contribution which, through application proved in actual service, has advanced the art of transportation, whether by land, sea or air." To all these fields, Dr. Sperry made engineering contributions.

The award was given to W. F. Gibbs, Hon. Mem., in 1955 for the concept and design of the SS *United States*, and in 1956 to Donald Douglas for developing the DC series of aircraft.

An interesting sidelight of the presentation was the presence of C. F. Kettering, 82, a Fellow of ASME, and holder of many of America's top engineering citations for his research in the automotive and other fields. Seated at the speakers' table, Mr. Kettering saw his son, Eugene, receive the Sperry Award.

ASME and ARS Plan Assures Broader Co-operation

Closer co-operation between two of the nation's leading technical societies was evidenced when The American Society of Mechanical Engineers and the American Rocket Society jointly announced that in the future each will have representation on the other's appropriate administrative group. The step was designed to further improve working relationships between the two groups, which have been affiliated for some years. Both societies have headquarters in New York.

Eugene W. Jacobson will represent ASME on the ARS board of directors, while Robertson Youngquist will fill the corresponding role on ASME's Board on Technology. Each will take part in deliberations but will not vote.

Mr. Youngquist is the director of the Component Development Division of Reaction Motors, Inc., of New Jersey. A graduate of the Massachusetts Institute of Technology, he served in World War II as a Navy Lieutenant. He is a member of ASME as well as ARS and is former editor of the *Journal of the American Rocket Society*.

Mr. Jacobson, a native of Nebraska, received a bachelor's and master's degree in engineering from the State University. He is chief design engineer in charge of the Design Section, Executive Branch, of the Gulf Research and Development Company. Holder of three certificates of award for his work in the ASME, he is, besides liaison representative to the American Rocket Society, a director (technology) of The American Society of Mechanical Engineers.

Nuclear Policy and Reactor Progress Among Highlights of . . .

. . . New York Nuclear Meetings

THE second winter meeting of the American Nuclear Society, the fourth annual conference of the Atomic Industrial Forum, the 1957 Trade Fair of the Atomic Industry, a special conference on reactor safety, and the annual meeting of the Professional Group on Nuclear Science of the Institute of Radio Engineers were held Oct. 28–31, 1957, in New York, N. Y. More than 2000 registered for the ANS and AIF sessions.

U. S. and U. K. Policy

At the Joint ANS-AIF Banquet, William Strath, member for external relations and commercial policy, U. K. Atomic Energy Authority, and Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, compared the nuclear development programs of the two countries.

Britain's plan, based on a critical fuel shortage, anticipates that about a quarter of all her electricity will be nuclear within the next ten years, and will be fully competitive with conventional power toward the end of that period.

Her program is predominantly based on the gas-cooled graphite-moderated concept with intensive development being done on long-lived fuel elements; techniques for obtaining higher temperatures which will bring lower capital costs and higher thermal efficiencies; and on the use of improved materials. A 30-per cent reduction in capital cost per kilowatt is expected from this research, with the cost per kilowatthour dropping from 7 or 8 mills to perhaps 5 mills. A gas-cooled reactor to operate at much higher temperatures—in the region of 800 C—and a 60-mw heat-output reactor are under development.

The United States role, according to Admiral Strauss, "is to explore and develop the widest possible range of the most promising types of power reactors," although our fossil-fuel and undeveloped hydroelectric potential should be adequate for at least another generation. "We seek to establish at the earliest feasible time, an independent nuclear-power industry—independent in all its stages from concept to operation—independent from Government domination or Government subsidy."

He stated that it was his firm belief "that within a decade we shall see established in the United States an industry that has completely taken over, and has assumed its proper independent role, in the field of the peaceful uses of atomic energy. At that time, it is our hope that the Commission's activities—while still perhaps necessary in the field of the military atom, unless we shall by then have achieved our hope of a safeguarded international system of disarmament—will be limited to assuring uniform safety regulations."

New Concepts

Among the new concepts considered in the ANS sessions were new methods of control. Moderator control was advocated to replace the familiar control rods, for both the boiling-water and pressurized-water reactors.

Critical masses, conversion ratios, and neutron balances have been computed for various reactors employing UF_4 for the development of a homogeneous molten fluoride reactor concept.

The so-called "neutron-amplifier" principle in which two or more subcritical regions are permitted to interact through a "rectifying" neutron valve of moderator and thermal poison, has been proposed as a means of exciting a large subcritical power region with a small easily controlled source.

Reactor Progress Reported

An entire joint session of the ANS and AIF was devoted to operational experience with the Army Package Power Reactor, reported more fully in the "Briefing the Record" section of this issue. In addition to the papers on physics, chemistry, and other aspects of nuclear development, progress reports on several major commercial power reactors were given in the AIF sessions. The Sodium Reactor Experiment which will lead to commercial power development achieved criticality in April and first power generation in July. The SRE has had two trial runs for the generation of power with stable operation. Minor difficulties such as uneven heating on some of the large sodium tanks and leakage from the lower plenum were corrected. Electromagnetic eddy-current brakes are to be added to program the flow decay to match the power decay subsequent to a scram in order to minimize thermal stresses, particularly in the moderator cans and in the core tank.

The Shippingport pressurized-water reactor received its first core on October 6. The pre-operational test programs had swung into full gear last summer. Hydrostatic testing of the main coolant loops culminated when a pressure of 3750 psi was sustained for 30 minutes in the primary system, designed for 2500 psi. Efforts are being concentrated on the final touches of plant construction, checking out the plant control system, and testing the many component systems. The head of the reactor vessel is in place, and the plant is being readied for criticality. Additional testing for design verification and determination of any plant limitations is under way.

Con Edison's Indian Point Plant is in the foundation-excavation stage. Experiments by Babcock & Wilcox to secure the necessary design constants, particularly on thorium, for this pressurized-water system have been under way since March. Their fuel-element and reactor-materials research is also in progress, and a primary loop and other laboratory facilities are being constructed at the National Reactor Testing Station near Arco, Idaho. All of the major equipment for the conventional portion of the plant has been purchased. Initial fabrication of the reactor vessel and nuclear boilers is proceeding.

Detail design on the boiling-water Dresden Station is now about two thirds complete, with final completion set for late 1958. Seventy-five per cent of the estimated total procurement cost has now been committed with detailed engineering completed by subcontractors on the major pieces of equipment. Construction was ten per cent complete on October 1, with completion set for early 1960 and operation later that year.

By the end of this year the Pennsylvania Advanced Reactor Project will have spent $5.5 million toward determining the technical and economic feasibility of a large aqueous homogeneous reactor of the single-region slurry type, for central station application. Initial evaluations of the feasibility of each major component are complete, and development has started on some. The problems of gaseous recombination, slurry-concentration control, radiation effects, flow distribution in large vessels, and many others are formidable. They will require considerable additional work before a firm plant design can be established.

The sodium-graphite reactor for the Consumers Public Power District of Nebraska is expecting authorization shortly from the AEC to proceed with the research, development, and engineering. The reactor proposed will be a heterogeneous-assembly, liquid-sodium-cooled, graphite-moderated type with stainless-steel-clad fuel elements.

Ground was broken in August for the Enrico Fermi 100,000-kw fast-breeder reactor in Michigan, and construction is in progress. A delay in fabrication of certain important components, chiefly the reactor vessel, has postponed the date for criticality to the early fall of 1960. Erection and initial pressure testing of the vessel was completed on October 6. Piles have been driven for the sodium-handling facility to serve both the test facility and actual plant.

Test Reactors

Status reports were also given for several test reactors. The Experimental Breeder Reactor No. 2, at the National Reactor Testing Station, will be under construction next spring. The Homogeneous Reactor Experiment No. 2, at the Oak Ridge National Laboratory, was completed, and preoperational testing begun in the summer of 1956. It was operated a total of 1382 hours during January, February, and March with water at full temperature and pressure. These runs emphasized weaknesses in equipment performance, and dismantling was begun in April, 1957, and careful inspection undertaken. Repair was completed in August and the reactor has completed 450 hours of completely satisfactory operation with hot water at design conditions and preparation is being made for critical experiments. The Liquid Metal Fuel Reactor Experiment is in the reference-design stage.

The problem of applying nuclear technology to process heat applications, the economic potential, and other considerations were among the subjects surveyed.

These included a feasibility study of the plasma fission reactor. This was termed an "extrapolation of existing techniques far beyond the point of present day engineering knowledge."

Some of the problems and some of the benefits to be gained from fusion reactors also were outlined.

Atomfair

The first atomic trade show ever held in New York City drew exhibits from 137 participating organizations. Virtually every major reactor builder was represented, and there was a separate instrumentation section representing a significant cross section of the firms supplying nuclear instrumentation and controls. Several of the national commissions and authorities for nuclear development participated. In addition to the AEC, the United States was represented by exhibits from Argonne, Brookhaven, and Oak Ridge National Laboratories, as well as the Bureau of Standards and the Department of Commerce.

Atomic Energy of Canada, Ltd., had a display of some of the products and services of its commercial products division. The Comitato Nazionale per le Richerche Nucleari detailed some of Italy's fundamental and applied research, paying tribute to Enrico Fermi's contribution. The installations at Saclay and the geographical distribution of France's atomic industry were shown by the Association Technique pour la Production et l'Utilisation de l'Energie Nucleaire.

The American Institute of Physics and the American Association for the Advancement of Science were among the societies represented, which included the ANS and the AIF.

How Technical Skill of Young Men Rescued Paint Industry

C. F. Rassweiler Wins 1957 Industrial Research Award

How a small group of young technical men effected a scientific revolution in the paint industry during the depression years, resulting in a material increase in sales and profits for their company, was revealed at the annual meeting of the Industrial Research Institute, May 7, at Buck Hill Falls, Pa.

Speaking before many of the leading industrial research executives of the nation as the recipient of the 1957 Industrial Research Institute Medal, Clifford F. Rassweiler, Mem. ASME, vice-chairman of the board and vice-president for research and development of Johns-Manville Corporation, told how in the period from 1927 to 1937, the foundation was laid for the technical modernization of the paint industry and the conversion of most of its products from a natural oil to a synthetic resin basis.

Prior to joining Johns-Manville in 1941, to develop at Manville, N. J., the largest research laboratory in the world devoted to building materials, insulations, and allied industrial products, Dr. Rassweiler was for 17 years with the research organization of E. I. du Pont de Nemours & Co., Inc. During this period he helped organize the new Central Technical Laboratory of the du Pont Paint Division, serving as its assistant director. Later, it became known as the Philadelphia Laboratory. Dr. Rassweiler became director of this organization in 1932.

Research Effects Change

It was the research accomplishments at the Philadelphia Laboratory that enabled du Pont to effect a radical change in the manufacture of paints. The new developments were eventually adopted by the entire paint industry.

The Philadelphia Laboratory was organized in 1927, and staffed by du Pont with young technical men from outside the paint industry. Their mission was to convert the du Pont paint business from "rule of thumb" production to a scientific basis.

Deficiencies of the paint industry's products in 1927 were glaring and obvious, Dr. Rassweiler said. They were slow drying, stayed soft for long periods, and if they were hard, they were also brittle. The outdoor durability of the best enamel products was less than a year, and all paints tended to chalk, lose gloss, and fade rapidly on outdoor exposure. White enamels turned yellow when not continuously exposed to direct sunlight. Ability of oil and varnish-type paints to protect steel against corrosion was so low that aluminum flake had to be used as a pigment.

The Philadelphia organization assembled to tackle these problems was small, young, and had scant facilities, Dr. Rassweiler recalled. The number of technical men in the laboratory in 1927, and again in 1940, was approximately 50 but dropped as low as 27 during the depression years in between. Both personnel and supervisory force of the laboratory was almost entirely in their late 20's or early 30's. The laboratories

consisted of one converted floor of an old warehouse and the converted second floor of an old stable where hay had been kept when paint products were delivered by horse-drawn dray. There were no pilot plants.

Paint Industry Needed Binder

What the paint industry needed, Dr. Rassweiler said, was a new vehicle or binder with radically improved properties and capable of sufficient modification to make it versatile enough to be applied to a broad range of paint requirements.

The du Pont Philadelphia Laboratory's eager beavers turned to a distinctly "dark horse," Dr. Rassweiler said. This was a combination of glycerin, phthalic anhydride, and drying oil acids —a group of compounds called alkyd or glyptal resins which today form the basis for a high percentage of the finishing materials sold in this country.

"It is doubtful if any new material has ever fitted the needs of industry as well as drying oil alkyd resins fitted the varied needs of the paint industry," Dr. Rassweiler reported. "By modifying the nature and amount of drying oil and the methods of manufacture, resins could be made which were suitable for almost all of the purposes for which oil-line paints and enamels were used. They could be applied by any of the traditional methods without unusual surface preparation and they had almost all the desirable properties of the oil products."

Impact of Alkyd Resins

"The tremendous impact of alkyd resins on the paint industry stemmed from the fact that finishes made from them provided an entirely new standard of service performance," he said. They dried rapidly and were both hard and tough. Enamels stayed white in the dark. Within a few years, finishes of this type were widely adopted as:

1 General industrial finishes for interior and exterior use.

2 Finishes for mechanical refrigerators.

3 Gloss-retaining finishes for automobiles.

4 Architectural enamels for home use.

5 Metal protective finishes for bridges, ships, and other structures.

Today, a large percentage of the finishes sold by the paint industry are of this type.

"Public recognition is due," Dr. Rassweiler said, "to the small group of technical men who, during ten years of the depression, achieved this scientific and commercial accomplishment, whose magnitude and significance have never been properly recognized even among industrial-research people."

Dr. Rassweiler specifically named the late John Marshall, first Director of the du Pont Philadelphia Laboratory, from 1927 to 1932, and after whom the Laboratory is now officially named, and four other industrial-research pioneers present at the annual meeting.

These were: Dr. Horace H. Hopkins; Dr. Paul Robinson, who has been in charge of resin development work at the du Pont Philadelphia Laboratory since its original organization; J. Wesley Iliff; and James Bullitt, who had a key role in the development of industrial alkyd and urea-formaldehyde finishes, and is now Director of the Research Division of the du Pont Company's Fabrics and Finishes Department.

Graduate-Study Program for Western Electric Engineers

Industry Joins With Universities to Provide Advanced Study for Its Engineers

A GRADUATE-EDUCATION program has recently been made available to engineers of the Western Electric Company. The company in co-operation with several leading universities will provide full-time off-the-job training designed specifically for its engineering body. The program is equivalent in cost and administrative effort to the establishment of a new engineering school of 1000 full-time students.

Currently, six universities are co-operating in the program: New York University, Northwestern, Illinois Institute of Technology, Cornell, Duke, and North Carolina State.

Classes are being conducted on these campuses and at three specially equipped centers in New York, Chicago, and Winston-Salem. Each of these centers will include laboratories, libraries, study halls, classrooms, and related facilities.

The first of the three training centers was opened on June 17, 1957, at the Coliseum Towers, New York, N. Y.; construction of the Chicago and Winston-Salem centers is now in progress. Instruction for the initial class was arranged through the New York University, Office of Special Services to Business and Industry.

The first nine-week course is available to newly employed Western Electric engineers after four to six months on full-time engineering assignments. Under the title: "Introduction to Western Electric Engineering," the series will cover communication systems, planning for manufacture, product design principles, and communicating ideas. Engineers become eligible for the second phase of study, "General Development," after they have returned to their job assignments for six to twelve months.

Subsequently, those who have completed the first two phases of study and other experienced engineers are available for the Advanced Development phase. Participation in this phase of the study program is dependent upon individual qualifications, needs, and capacities without regard to age or length of service. Courses in this segment of the program will provide intensive training in such subjects as operations research, industrial control devices, engineering statistics, planning of manufacturing facilities, computer theory, advanced tool design.

Western Electric instructors and instructors recruited on a part-time basis from co-operating universities will train approximately 2000 students annually in full-time off-the-job study.

Meetings of Other Societies

Dec. 15–18

American Society of Agricultural Engineers, winter meeting, Edgewater Beach Hotel, Chicago, Ill.

Dec. 17

Institute of Aeronautical Sciences, Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

Dec. 17–19

National Science Foundation, conference on nuclear sizes and density distribution, Stanford, Calif.

Dec. 30

National Science Foundation, one of many sponsors of scientific manpower conference, Indianapolis, Ind.

Jan. 27–29

American Society of Heating and Air Conditioning Engineers, Inc., annual meeting, Pittsburgh, Pa.

(ASME Coming Events—see page 1260)

Literature

Power Test Codes

"Determining Dust Concentration in a Gas Stream" is a revision of the original ASME Power Test Code related to the abatement of atmospheric pollution. The revised code was approved by the Power Test Codes Committee on April 3, 1957. It was approved and adopted by the Council as a standard practice of the Society by action of the Board on Codes and Standards, on April, 29, 1957.

Copies of the code cost $2.50, and may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Proceedings

• The "Proceedings of the Third General Assembly" of the Engineers Joint Council held January 17 and 18, 1957, in New York, N. Y., are now available. The problems of the engineer in government service; the economic status of the engineer; and the impact of the engineer in international relations are the subjects covered in the proceedings.

The 47-page report costs $1, and may be obtained from the Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

• The "Proceedings of the 12th Annual S.A.M.-ASME Management Engineering Conference" held April 25-26, 1957, in New York, N. Y., are now available.

The 271-page, paper-bound book contains 16 papers dealing with such subjects as operations research; work measurement, wage incentives, material handling, integrated data processing, cost reduction, and management of industrial engineering.

Copies cost $3.50 to members of SAM and ASME and $5 to nonmembers. They may be obtained from the Society for Advancement of Management, 74 Fifth Avenue, New York 11, N. Y.

Management

• Four additions to the American Management Association's General Management Series of publications are now available. They are compilations of material presented at the General Management Conference of the AMA in Los Angeles, Calif., January 28-31, 1957.

Titles of the publications are: "Small Business: Problems and Prospects," No. 184; "Planning for Growth: Three Company Programs," No. 185; "Improving Managerial Performance," No. 186; "Improved Techniques for Administration and Control," No. 187.

The publications cost $1.75 to nonmembers, and $1 to members. They may be obtained from the American Management Association, 1515 Broadway, Times Square, New York 36, N. Y.

• "People's Capitalism," part 1 of a report on The American Round Table discussions held at Yale University, November 15 and 16, 1956, is now available. The 64-page report tells how a group of 12 leading Americans attempted to answer one of the biggest questions facing this country today. The question: What can be done to correct the fantastic and often dangerous misconceptions about the American economic system that exist around the world?

The report costs 25 cents and may be obtained from the cosponsor of the discussions, The Advertising Council, 25 West 45th Street, New York 36, N. Y.

Titanium

"Research and Development for the Welding of Titanium Alloys," by J. J. Chyle and I. Kutuchief is the authors' final report on studies by the A. O. Smith Corporation for U. S. Army Ordnance.

The 79-page report describes successful welding of titanium alloys containing chromium, iron, manganese, aluminum, and molybdenum by the inert-gas shield tungsten-arc welding process.

The report costs $2, and may be obtained by ordering PB111849 from the Office of Technical Service, U. S. Department of Commerce, Washington 25, D. C.

New Publication

The "Atomic Energy Review," a new publication of the General Electric Company, Ltd., will be published twice yearly. The first 60-page issue appeared in March, 1957, and carried 11 articles concerned with reactor physics, fuel element design, heat transfer, metallurgical research, and others.

For further information write: The General Electric Company, Ltd., Magnet House, Kingsway, London, W. C. 2.

Engineering Education

"Recruiting Practices and Procedures," a new code of interviewing is now available. The code lists the responsibilities of the employer, the college, and the student in the interviewing situation.

Copies of the five-page report cost 25 cents; five for $1; and 15 cents each for 50 or more. They may be obtained from W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

Abrasive Wheels

The revised American Standard Safety Code for The Use, Care, and Protection of Abrasive Wheels, B7.1-1956, contains many innovations which make it more usable and understandable to the consumers of abrasive wheels.

The many new features include material on the revolving cup guard, the depressed center wheel, new maximum speed tables for mounted wheels, and the two-column format.

Copies of the revised Code may be obtained free of charge by writing the Grinding Wheel Institute, 2130 Keith Building, Cleveland 15, Ohio.

Investment Castings

The "Engineering and Design Manual" published by the Investment Casting Institute, is now available. Cost of the manual is $5. Orders may be placed with the Investment Casting Institute, Chicago 3, Ill.

Transactions

The "Transactions of the 21st annual meeting of the Industrial Hygiene Foundation" have been published recently. The 281-page, paper-bound book includes technical papers and discussions presented at the management, medical, legal, engineering, chemical-toxological, and joint technical conferences of the foundation. The book may be obtained through the Industrial Hygiene Foundation of America, Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa.; it costs $5.

Glass

"Windows and Glass in the Exterior of Buildings," discusses the new ways in which glass windows and related products are used today in all types of buildings. Research directors detail some of their most recent findings in the field of daylighting; heating, air-conditioning, and ventilating engineers discuss problems and solutions; manufacturers describe new types of windows, new uses for glass; building owners relate their experiences with controls, and the reactions of occupants; control experts point out the benefits and detriments of interior and exterior control systems; architects elaborate on design applications in residential, commercial, and institutional construction.

The 176-page book costs $5. Inquiries concerning this publication may be addressed to the Building Research Institute, National Academy of Sciences and National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Industrial Films

Coated Abrasive Disk Grinding

"Metal Finishing with Coated Abrasive Discs" is a presentation of the newest coated abrasive disk grinding theory and practice for finishing metal. Filmed on location in industrial plants across the country the motion picture discusses the causes and cures of disk grinding problems.

The 20-min, 16-mm, color and sound film is available upon request from Behr-Manning, Motion Picture Department, Troy, N. Y.

Research

"Research—Key to Progress," a motion picture which documents the role of scientific research in the national economy, has been produced by Armour Research Foundation of Illinois Institute of Technology.

Presented as a public service, the 15-min, 16-mm, color film traces the rise and contribution of research, particularly by industrial research organizations.

Arrangements for showing the film can be made by writing to the Public Relations Department, Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th Street, Chicago, Ill.

Plastic Pipe Covering

A pipe insulation that saves up to 50 per cent in installation time over conventional insulation is described in an 11-min, sound-slide film recently released by the Insulation Division of the Armstrong Cork Company.

The film is a discussion of Armaflex, a new, flexible, foamed plastic pipe covering. Designed originally for residential air-conditioning and dual-temperature lines, the new insulation has been found to be extremely practical in preventing condensation on any residential-commercial copper tubing or iron pipe operating in a temperature range of 32-200 F. Because of its flexibility, Armaflex can be applied to new or existing pipes with a minimum of fitting cover fabrication and only one sundry material, saving about half the labor necessary with other insulations. The film states that application is so simple, no special tools or skills are required.

Interested groups may contact any Armstrong district office, or the company's insulation division, Lancaster, Pa., to arrange for showing.

Standards Testing

"Testing Mass Standards by Substitution" is a film which presents recommended procedures for testing mass standards by substitution weighing. Designed primarily as a training aid to weights and measures officials, the film may also be useful to science classes and laboratory personnel. It demonstrates a simple method for quickly determining with a high degree of precision the mass of an "unknown" standard by comparison with one of known value. This is known as "error testing." Also demonstrated is the technique of "tolerance testing" a simpler procedure used when determining whether or not the error of a standard is within certain prescribed limits.

Convenient forms for recording and computing results in error testing and tolerance testing are illustrated and explained. The several steps in each method are demonstrated by means of successive entries of data on the appropriate form.

The 16-mm color and sound film was produced by the National Bureau of Standards at the request of the National Conference on Weights and Measures. For information about the loan or sale of this film, write to the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.

Lookout Point Dam

"Key to the Emerald Empire," a 28-min color and sound film tells the story of the construction of Lookout Point Dam on the Middle Fork Willamette River, Ore. The 16-mm motion picture traces the building of this key unit in the Corps of Engineers' Willamette River Basin multiple-purpose project and Lookout Point's reregulating unit, Dexter Dam.

Also available for showing are other 28-min color and sound films describing work on the Dalles Dam on the Columbia River, the Detroit Dam on the North Santiam River, Mud Mountain Dam on the White River, and Albeni Falls Dam on the Pend Oreille River.

Address requests for films to the Technical Liaison Branch, North Pacific Division, Corps of Engineers, 210 Custom House, Portland 9, Ore.

Hydraulic-Tool Maintenance

A film describing maintenance and trouble-shooting procedures for Huck hydraulic driving tools is now available from Huck Manufacturing Company, 2480 Bellevue Avenue, Detroit 7, Mich.

The 30-min, 16-mm, black and white slide film with synchronized sound track, describes in detail the construction and operation of the Model 126 hydraulic pull gun, which is used for installing Huck-bolt fasteners and blind rivets. Maintenance procedures for removal, repair, and replacement of the various working components are illustrated in simple step-by-step sequences.

Industrial-Film Production

"Industrial Motion Pictures," a booklet which gives the industrial photographer information on producing low-cost films, has been issued by the Eastman Kodak Company. The 76-page booklet was prepared after months of extensive research carried out in coordination with industrial companies all over the country.

Portions of the book are devoted to equipment and procedures, pictorial continuity, lighting, special effects, and a discussion of industrial applications of motion pictures—motion and time study, slow motion, time lapse, methods comparison, and others.

At the conclusion of the book are five pages of complete data on 16-mm Kodak films.

The booklet is available from Kodak dealers for 50 cents.

Material-Handling Film Catalog

Over 60 material-handling educational and training films are offered for loan, free of charge, by member companies of The Material Handling Institute, Inc. The films are listed in the 24-page, newly revised MHI catalog of "Material Handling Films," which is available free on request.

The films cover all phases of material handling and are grouped according to twelve major categories. Batteries and battery care, conveyers, cranes, fork lift trucks, lift truck attachments, material handling—general, maintenance, mechanized handling—by industries, overhead handling, safety, special equipment, and unit loads.

Included in the catalog is a descriptive résumé of each film together with its running time, whether in color or black and white, and ordering information.

Catalogs may be obtained by writing The Material Handling Institute, Inc., Suite 759, One Gateway Center, Pittsburgh 22, Pa.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

Over 500 Attend the First
ASME POWER CONFERENCE *at Allentown, Pa.*

Discussions of two new power stations, generator rotor bursts, testing techniques, design improvements in rotor-blade fastenings, cooling tower applications, and nuclear power developments provided an excellent program for the more than 500 attending the first Power Conference, sponsored by the ASME Power Division with the co-operation of the Anthracite-Lehigh Section, at Allentown, Pa., October 20-23, 1957. There were 42 participating in the women's program which included a luncheon and tour of the Moravian buildings in Bethlehem, and a smorgasbord supper.

Banquet and Luncheon

Division pride was at its height at the banquet, which was addressed by ASME President W. F. Ryan, who has retained an active interest in the division in spite of the responsibilities of his office, and who emphasized the importance of power in the field of mechanical engineering.

Mr. Ryan spoke of the "widsom of our predecessors in setting up these professional divisions"; and of the fact that "the joint conference is the best protection against splintering and fragmentation."

Joint conferences, he stated, provide an opportunity for co-operation with related divisions, and there are a number whose field of interest partially coincides with that of the Power Division. The division is already joint sponsor of a number of sessions at the annual and other general meetings of the Society, and has an opportunity to expand this type of co-operation at the conference level. Since Power is the largest truly professional division, being outnumbered only by Management which is of interest to all engineers, it has a great responsibility to serve the interest of its members.

Management has been particularly successful in the number of conferences co-sponsored—there were five this year: at Worcester, Mass.; Pittsburgh, Pa.; Los Angeles, Calif.; Skytop, Pa.; and New York, N. Y. Power could potentially sponsor many joint conferences when the full range of fuels, types of power application, metallurgical, technical and functional problems, instrumentation, and other related interests are considered. The ASME Power Division will be a co-sponsor of the American Power Conference, which is well established, and there are undoubtedly other similar opportunities for participation with other organizations.

President Ryan stated that he was "glad that the Power Division's first sample is one that you like," and pointed out that division conferences grow in value and participation as they develop, attracting foreign interest in time. The power conference at Boston, Mass., next year offers an opportunity for even greater success.

Herbert Estrada, Mem. ASME, and president, Philadelphia Electric Company, in introducing Mr. Ryan, complimented the Anthracite-Lehigh Section in view of the extra effort required for a first conference.

William G. McLean, Mem. ASME, and Head of the Department of Mechanics, Lafayette College, was the toastmaster; and the Lafayette College Quartette in which engineers outnumber liberal-arts majors by three to two—the pianist is an electrical engineer—presented several selections.

At the welcoming luncheon, W. S. Brokenshire, vice-president, engineering, Pennsylvania Power & Light Company, introduced the Hon. Donald Hock, Mayor of Allentown. After a humorous discourse on the duties of a mayor, particularly one who "had been given a four-year sabbatical leave between terms," the mayor spoke directly to the division's initiative in establishing the conference. He quoted Emerson to the effect that "the world belongs to the energetic," and pointed out that once the initiative had been taken there was solace in the law that "a body in motion tends to remain in motion."

Technical Sessions

Two new power stations, widely different from each other, were the topics of individual sessions, and an inspection trip was made to one of them.

The Portland Station, being installed by the Metropolitan Edison Company a few miles below Delaware Water Gap, was a subcritical application of the C-E Sulzer monotube boiler, previously employed in this country for supercritical installations. Coupled with a cross-compound single-flow turbine with axial exhaust, it will be operated by the direct-energy-balance combustion-control system. Conventional control will also be provided as a precaution, since experience is lacking with this new system. An article on the design considerations for this plant will appear in Mechanical Engineering.

The Martins Creek plant, already in operation by the Pennsylvania Power & Light Company farther downstream on the Delaware River, is an almost completely outdoor type. Although this is generally regarded as more desirable in the south, the station has operated successfully through several Pennsylvania winters with a completely uncovered turbogenerator. Economy was a primary consideration, since the plant was expected to operate with only 20 to 40 per cent load factor throughout its life. Situated in the most highly interconnected region in the east, it is a peak-load plant intended for overnight and weekend shutdown. Specialized starting and loading techniques are used to compensate for the thermal stresses involved. Coal handling is unique, being gravity fed to the ball mills by four

Local ASME Arrangements Committee for the Power Conference, Allentown, Pa., *left to right, front row,* are: Kemal Feridun, C. E. Lewis, R. E. Boushey, J. R. Carlson, J. G. Miller; *rear,* Lou Inglese, F. T. Sandt, Roscoe Meadows, Jr., W. G. McLean, C. C. Curley, R. L. Hallman, T. E. Jackson, G. L. Master, D. R. Rees, and R. H. Swoyer

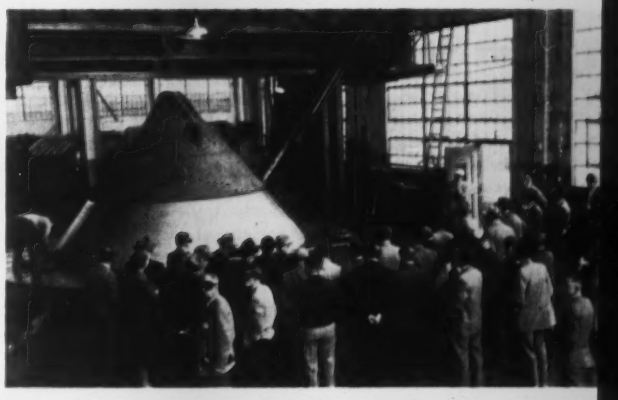
conveyer-loaded concrete silos situated at the top of the plant. The elimination of right and left-handedness in the two units resulted in considerable economy and has greatly facilitated maintenance.

Turbine and generator rotors were the topic of another unified session particularly concerned with the failure of ultrasonic inspection to detect certain flaws responsible for a generator rotor burst at the Pittsburgh, Calif., station of the Pacific Gas and Electric Company. A thorough review of the physical principles involved has forced a re-evaluation of this testing technique which should lead to recommendations within a few months. Stresses in the vicinity of a collection of filamentous inclusions were responsible for the Pittsburg failure, and it is possible that the only detectable inclusions are those in which microseparations have been opened by operational stressing. The Pittsburg burst also re-emphasized the need for improving large rotors. Design improvements in rotor-blade fastenings were also discussed in relation to operating experience with high-temperature steam-turbine rotors.

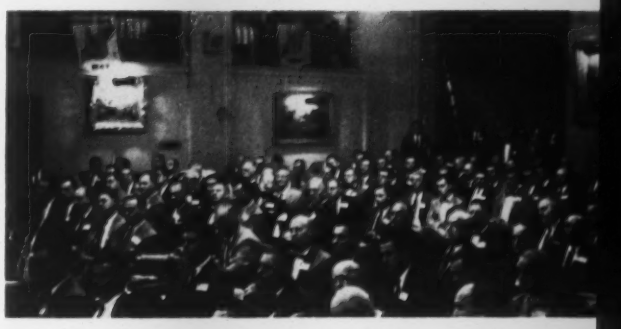
Increasingly, power stations will have to resort to cooling towers as water supply becomes more critical. Some of the factors in their selection and application were presented at the opening session. One discusser also suggested the use of ponds as a natural substitute for cooling towers. Experience has shown that only a few hundred yards of separation are necessary between intake and discharge if the pond is of any depth. The design considerations in the development of a cyclone-boiler installation, with unusual environmental handicaps, for process steam application were also presented.

The final session was devoted to nuclear power, with a survey of some of the current features and innovations in nuclear power designs, and a process description of the P. A. R. homogeneous

Banquet Head Table, *left to right,* ASME President W. F. Ryan; H. Estrada, Mem. ASME, Philadelphia Electric; R. Roushey, Mem. ASME, Roushey & Smith; C. B. Campbell, Mem. ASME, Westinghouse; R. E. Neidig; W. C. Astley, Mem. ASME, Philadelphia Electric; R. L. Hallman, Mem. ASME, Pennsylvania Power & Light



Inspection trip takes ASME Power Conferees to Bethlehem Steel Company Machine Shop where they viewed the blast furnace bell on vertical milling machine



View gives some idea of the large attendance at the Portland Station Session. The conferees overflowed onto the stairs and balcony. Registration was high throughout the first ASME Power Conference.

reactor. See MECHANICAL ENGINEERING, March, 1957, pp. 242–245, for a description of this reactor concept.

Digests of the papers presented will appear in subsequent issues of MECHANICAL ENGINEERING.

Inspection Trips

Inspection trips were taken to the Bethlehem Steel Corporation Plant, Bethlehem, Pa., where visitors were particularly interested in the vertical milling of a blast-furnace bell in the machine shop, and to the Martins Creek power stations. Plant personnel conducted the tour of the station and elaborated on the material presented in the technical sessions.

Availability List—1957 ASME Power Conference

THE papers in this list are available in separate copy form until August 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57—PWR-1	Design Considerations in the Development of a Cyclone-Fired Boiler Installation. . . For Kodak Park, Rochester, N. Y., by R. L. Young
57—PWR-2	Martins Creek Steam Electric Station. . .New Ideas to Reduce Cost of Construction and of Operation, by M. D. Engle
57—PWR-3	Axial-Flow Exhaust Turbine and Monotube Boiler. . .Are Basic Design Considerations of Portland Generating Stations, by J. G. Miller and R. H. Kreisinger
57—PWR-4	Effect of Heated Condenser Discharge Water Upon Aquatic Life, by Richard Van Vliet
57—PWR-5	Selection and Application of Cooling Towers in Steam-Electric Stations, by E. E. Goitein
57—PWR-6	Design Features and Development of the Cross Compound, Single Flow Turbine With Axial Exhaust. . .For the Portland Station, by J. E. Fowler and C. Matney
57—PWR-7	Controlled Starting and Loading of Modern Central Power Stations, by F. W. Kuehn
57—PWR-8	Unusual Features of the Portland Combustion Control System, by D. Scutt
57—PWR-9	Nuclear Power Trends, by W. T. Moore
57—PWR-10	Operating Experiences with High Temperature Steam Turbine Rotors and Design Improvements in Rotor Blade Fastening, by Joseph D. Conrad and N. L. Mochel
57—PWR-11	Ultrasonic Detection of Thin Laminar Inclusions, by S. Serabian and C. D. Moriarty
57—PWR-12	Investigation of the Generator Rotor Burst at the Pittsburgh Station of the Pacific Gas and Electric Company, by D. R. DeForest, C. Schabtach, L. Grobel, and B. R. Seguin
57—PWR-13	Pennsylvania Advanced Reactor Process Description, by Stanley C. Townsend, W. E. Johnson, and David H. Fax
57—PWR-14	The Condenser at Portland, by G. T. Jones

Is Your Atomic Language Precise?—New "Dictionary" Helps

FOR the first time, scientists and others interested in atomic energy will have a standard "dictionary" to establish precise meanings for hundreds of technical terms used in the rapidly growing nuclear field. The American Standards Association and The American Society of Mechanical Engineers announced jointly that a 188-page volume titled "Glossary of Terms in Nuclear Science and Technology" has been approved as an American Standard and will be published as such by ASME.

Common Language

The book is designed to provide a common language among medical men, engineers, chemists, physicists, biologists, and others working with the atom. It includes three categories of terms: (1) Those invented expressly for the field of nuclear energy; (2) those borrowed from other fields and employed here with different meanings; and (3) those used elsewhere, but which may be unfamiliar to nuclear workers. Definitions, tables, charts, and formulas considered useful are included in the glossary.

Among terms coined since the beginning of the atomic age are informal expressions which have achieved official status by inclusion in the glossary, such as "coffin" (a container for radioactive materials), "graveyard" (a place for storing burying containers of radioactive materials), and "parent" (an atom which splits to form "daughter atoms").

Technical Societies' Project

Approval by the American Standards Association is the culmination of a long project begun in 1948 by 21 technical societies with interests in the nuclear energy field. Instead of proceeding with limited glossaries, they joined to pool their efforts toward one comprehensive listing. The National Research Council was chosen as co-ordinating body and, since the ASME had made the most progress in a comprehensive directory, it was decided to use their work as a base. Other organizations worked on specific parts which were reviewed and revised by National Research Council's Board of Critics. A combined version of the nine separate sections thus produced was printed in 1955. The National Research Council, which is the copyright owner, submitted the newest glossary for approval as an American Standard in July, 1956. This version, containing additions and corrections, was published as an ASME Standard early in 1957, and served as a draft for ASA approval.

That the glossary has already found wide acceptance is evidenced by the fact that preliminary drafts were requested for use at the 1955 International Conference on Peacetime Atomic Energy in Geneva, and the 1957 Nuclear Congress in Philadelphia. Advance copies of the American Standard were studied at the Geneva meeting of the International Organization for Standardization's Nuclear Energy Committee which met July 29 through August 1. In addition, many authors and magazines have excerpted parts of the text and the British Standards Institution is using the American version as a base for its own dictionary.

Copies of the glossary, designated American Standard N1.1-1957, may be obtained, at $5 each, by writing to The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., or to The American Standards Association, 70 East 45th Street, New York, N. Y.

Papers Invited for Second Geneva Conference on Peaceful Uses of Atomic Energy

A PROCEDURE for the submission and selection of papers for the Second International Conference on the Peaceful Uses of Atomic Energy to be held in Geneva, Switzerland, Sept. 1–13, 1958, has been outlined by the U. S. Atomic Energy Commission.

Since the success of United States participation in this conference depends largely on the quality of the technical papers presented, according to the AEC, organizations are invited to submit names of authors, titles, and abstracts to be considered for submission to the Secretary-General of the United Nations.

Authors should prepare and submit abstracts of not more than 500 words by January 1, 1958. These should be as informative as possible to permit comprehensive review for subject matter.

Details of preparation are quite specific, and final copy should not be prepared without first obtaining information from the Technical Director, Office for International Conference, Atomic Energy Commission, 1901 Constitution Avenue, N. W., Washington 25, D. C.

Abstracts should be identified with the number on the Provisional Topical Agenda for which they are submitted. Length does not permit inclusion here, but submitted papers in general should be broad in scope rather than the presentation of results of individual research and development projects. However, results of important new discoveries not previously reported may be covered in some detail.

The topical agenda as proposed by the U. N. emphasizes power production. Therefore, papers on reactor technology should be included. Papers submitted must not be published prior to the Geneva Conference. It is the AEC's understanding that the United Nations will publish all the individual papers accepted, as well as a combined or summary paper, in the Proceedings of the Conference.

Now Ready, Second Nuclear Engineering and Science Conference Proceedings

THE Proceedings of the Second Nuclear Engineering and Science Conference have been published in three volumes for The American Society of Mechanical Engineers by the Pergamon Press. Vols. 1 and 2, for which John R. Dunning, Mem. ASME and dean of engineering, Columbia University; and Bruce R. Prentice, Mem. ASME and manager, Nuclear Systems Design Study, General Electric, were co-ordinating editors. They carry the general title "Advances in Nuclear Engineering," and contain the 138 papers and discussions presented at the conference. Volume 3 contains the more than 60 papers presented at the 5th Hot Laboratories and Equipment Conference, plus a considerable amount of material added by the authors after presentation of the papers.

The technical papers in volume 1 are divided into sections on Fuel Cycles, Plant Containment Concepts and Design, Plant Components, Waste Disposal, Protection and Safety Measures, and Radiation Processing. In addition to the technical papers, the volume has an introduction on the scope and purpose of the 1957 Nuclear Congress by General Chairman Walter G. Whitman, M.I.T.

The addresses which were delivered at the Congress are also included: "The International Outlook for Atomic Power," by P. F. Foster, assistant general manager for international activities, AEC; "A Message from Euratom," delivered by Alfred Iddles, Fellow ASME and president, Atomic Industrial Forum; "Is American Atomic Policy Lagging?" by Robert McKinney, chairman, Citizens Panel on the Impact of the Peaceful Uses of Atomic Energy, which reported to The Congress last year; and "Nuclear Engineering: A Challenge," by W. Kenneth Davis, Mem. ASME and director, Reactor Development, AEC.

The technical papers in vol. 2 are divided into sections on Reactor Design, Reactor Core Design, Reactor Operation and Maintenance, Educational Use of Reactors, Metallurgy, Natural Resources, Instrumentation, Heat Transfer, and Standardization in the Nuclear Field.

The first two volumes are available together for $35 and the third volume for $17.50 from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. All volumes are fully illustrated.

IRE, ISA, AIChE Participate in Fourth Annual IRE-ASME Conference Program

THE Instrument Society of America, the IRE Professional Group on Automatic Control, and the Process Control Committee of AIChE have all accepted an invitation from The American Society of Mechanical Engineers to participate in a national conference on the design and application of systems that automatically maximize yield, efficiency, and performance, or minimize incremental cost. The University of Delaware and the ASME Wilmington Section will play host to the three-day conference, scheduled for April 2–4, 1958. Top engineers in the measurement and control field are expected to attend from all over this country and from other countries.

Plans call for five technical sessions to cover all phases of optimizing:

Session 1—Introduction to Principles and Design Techniques

(*a*) What optima are—how the design and application engineer can discover them.

(*b*) Analytical techniques—cases in which the engineer can use them.

(*c*) Situations in which he cannot use analytical techniques—how he then programs a computing controller to seek an optimum.

Session 2—Problems and Applications in Manufacturing and Metalworking

Session 3—Problems and Applications in Processing Industries and Utilities

Session 4—Problems and Applications in Missiles, Aircraft, and Weapons

Session 5—Opportunities, Challenges, and Future Approaches

In addition to the planned technical program, the local committee has arranged plant visits and social activities as well. Conference registrants may choose from the following trips scheduled for the afternoon of April 2:

Tidewater Oil's Delaware City refinery, the latest in refinery instrumentation;

Electromechanical department, Mechanical Development Laboratory, E. I. du Pont de Nemours, where automatically controlled mechanical processes are developed;

Chrysler-Plymouth assembly plant, and

Delaware Power and Light Generating Station.

To encourage attendance of the registrants' wives the program committee has arranged for a tour of Winterthur while the engineers "tramp" plants. Winterthur, a museum of early Americana collected by Emory du Pont, has entire wings in period furnishings.

North American Coal-Energy Reservoir Tapped for Theme of Meeting at Chateau Frontenac, Quebec City, Canada, October 10 and 11, CIM Hosts to . . .

ASME-AIME Joint Solid Fuels Conference

TRADITIONAL Canadian-American cooperation was a salient feature of the 20th Annual Joint Solid Fuels Conference, sponsored by the Coal Division of the American Institute of Mining, Metallurgical and Petroleum Engineers and the Fuels Division of The American Society of Mechanical Engineers. The host for the conference was the Coal Division of the Canadian Institute of Mining and Metallurgy. Over 225 representatives of education, government, and industry attended the conference held on October 10 and 11, at the Chateau Frontenac Hotel, overlooking historic Quebec City, Canada.

The "Coal-Energy Reservoir of North America" was the theme of the conference which noted the importance of coal as a source of energy in the past, and predicted that coal would continue to satisfy a vast portion of the energy requirements of the future.

The enthusiasm with which the conference—four technical sessions, luncheons, and banquet—was received, was typified by the attendance at the fourth and final session for which over 100 registrants remained.

Technical Sessions

Canadian Coal Picture. The inaugural session of the conference was offered entirely by the Canadian hosts. The resource, transportation, and utilization aspects of Canadian coals as well as factors that influence the utilization of American coal in Central Canada were the subjects of the five Canadian papers.

Coal will continue to be a major source of Canadian energy as industry continues to expand, according to C. L. O'Brian, Dominion Coal Board, Ottawa. The iron and steel industry is expected to grow rapidly. This industry, until some other process of reduction of ore is developed, will require large quantities of coke for blast furnaces and consequently will provide an expanding market for coal.

In areas of Canada where economic hydroelectric power is being exhausted by growing needs, coal will be required for the production of thermal-electric power. This trend, noted by G. M. Hutt, Canadian Pacific Railways Company, Montreal, is witnessed by current plans for the development, in Ontario alone, of 5.2 million-kw thermal-electric power requiring some 15 million tons of coal per year.

Most of this coal will necessarily come from sources in the United States. With the completion of the St. Lawrence Seaway, it is hoped that transportation of this coal will be facilitated. J. R. Frith, The M. A. Hanna Company, Cleveland, Ohio, pointed to the tremendous industrial growth that is forecast along the Seaway. It is likely that within a few years the coal requirements of that new industry, together with the requirements of the thermal-power plants which will have to be built to supply its increased power needs, may involve the consumption of several million tons of additional coal per year.

Where is the coal that will satisfy the ever-increasing demands of industry? G. M. Hutt indicated that the coal for Canadian industrial consumption, especially for the railway and the coke and gas industry, will be available from foreign and indigenous sources.

Given the range of coal that is available to Canadian consumers, it is significant to note the individual factors which affect coal selection. In central Canada where coal in transit is sometimes subjected to seven different mechanical handlings—mine to stoker hopper—it is essential that the limiting factors affecting coal selection be considered; however, such factors in varying degrees affect coal selection in any area. The selection of coal for a given plant, according to G. P. Cooper and W. J. Moroz, Assoc. Mem. ASME, The M. A. Hanna Company, Toronto, requires a technical knowledge of the various components which make up coal analysis, attendant physical properties of the coal, and the effect each property might have on the performance characteristics of the coal, as well as a complete knowledge of coal sources and transportation and handling systems. Dust and air pollution, fly-ash disposal, coal and ash handling, deserve consideration along with the cost per million Btu.

Production. Coal undeniably remains an important source of North American energy, but in order for the coal industry to maintain a competitive position with gas and oil, it must develop high-capacity coal-production machines together with simple and efficient mining systems.

The second session of the conference was concerned with the production aspects of the coal industry—improved methods of mining coal; effective dust control in mines; and flow of coal from bins.

Increased coal production in the United States was attributed to the "continuous miner" working in a "one place" mining system. The development of the "extensible belt" permits the mining and continuous driving of long rooms—up to 1000 ft—instead of the former standard room depth of 300 ft. P. R. Paulick, consulting mining engineer, Bethel Park, Pa., showed that the continuous miner has accounted for the increase in man-day tonnage production from 6.26 to 10.79 in the years from 1948 to 1957.

As mechanical production of coal increases, air-borne dust in underground rooms and entries creates the hazard of sustaining or propagating an underground explosion. Other hazards arise from accumulation of particulate matter in the lungs of operators and from the reduction of face visibility. The control of coal dust falls into the following categories: Prevention; dilution and collection of precipitation; and cleaning up or rock dusting. Collection or precipitation is probably the most applicable method of dust control. A mechanical dust collector for the collection of airborne particles was described by Donald

Speakers at the fourth session of the ASME-AIME Fuels Conference, *left to right:* T. R. Scollon, U. S. Bureau of Mines; H. B. Charmbury, Pennsylvania State University; E. D. Holdup, Hydro-Electric Power Commission of Ontario; V. C. Smith, Management Group Companies; and E. F. Osborn, Penn. State.

John Blizard, *above*, Fellow ASME and director of research, Foster Wheeler Corporation, New York, N. Y., is applauded as he accepts the Percy Nicholls Award from Carroll Hardy, Mem. ASME, National Coal Association, Washington, D. C. Mrs. Blizard smilingly applauds in the foreground.

Wiebe, Joy Manufacturing Company, Saltsburg, Pa. The collector is a wet collecting device utilizing the principle of high-velocity impingement and diffusion, as well as water separation.

In a boiler plant the success of automatic coal-burning equipment is dependent upon a uniform flow of coal from bin to boiler. Poor flow performance of conventional storage bins is due to central core movement responsible for "ratholes" and high pressures on coal which cause its adhesion to hopper walls. Experiments by F. D. Cooper and J. R. Garvey, Mem. ASME, Bituminous Coal Research Institute, Columbus, Ohio, showed that by using a 75-deg sloped hopper and an inverted cone of stainless steel, it was possible to handle one-quarter-inch coal containing 15 per cent moisture in a steady, reliable stream.

Preparation. Efforts are continually being made by preparation engineers to make maximum use of all mined coal. A session of the conference discussed preparations that provide solutions to the problems of fines disposal, anthracite for metallurgical uses, and freezeproofing of coal.

Pelletizing of coal fines was proposed by M. P. Corriveau, Clinchfield Coal Company, Dante, Va., and Thomas Linton, Link-Belt Company, Chicago, Ill., as a solution to the problem of fines disposal. The pellets produced, because of their attractive physical properties, strength, freedom from dust, and low moisture content, can command a premium over what is obtained by present methods of fines disposal.

The chemical and most of the physical properties of anthracite are similar enough to those of metallurgical coke that its use as a metallurgical fuel has been investigated over a period of years. Attempts were described by J. W. Eckerd and R. F. Tenney, U. S. Bureau of Mines, Schuylkill Haven, Pa., for preparing a thermally stable anthracite by means of calcination. Tests indicated that, under certain foundry conditions, calcined anthracite could be used as a cupola fuel.

Agglomeration of coal by freezing presents increased handling difficulties and costs to consumers. In the lignite-consuming regions of North Dakota, western Minnesota, and South Dakota, freezing conditions prevail for relatively long periods. Agglomeration of lignite by freezing is caused primarily by frost crystals, which cement individual particles together. A major and constant source of the moisture which produces these crystals is the natural moisture in the lignite itself. Tests conducted by R. C. Ellman and J. W. Belter at the U. S. Bureau of Mines, Grand Forks, N. D., indicate that oil treatment reduces the degree of agglomeration of lignite.

Utilization. Fourth and final session of the conference considered the utilization aspects of coal. The "use value" of competitive fuels was defined by V. C. Smith, Management Group Companies, Charleston, W. Va., as a term which represents a number of continually varying factors translated into the cost of the end product. It is the cumulative effect of production, beneficiation, transportation, availability, handling, and many other factors involved in conversion to useful energy.

Sound methods of solid-fuel evaluation can contribute to the determination of the use value of the solid fuels in thermal-power stations. Some physical characteristics of solid fuels and their effects on boiler-plant design and operation, were outlined by E. D. Holdup, The Hydro-Electric Power Commission of Ontario.

Recovery of fine coal associated with the solids reporting to the wash water in coal preparation plants has become increasingly important. A gravity method for cleaning extreme-fine sizes of bituminous coal has been developed and it utilizes stream flow action on an especially designed traveling belt machine. At optimum conditions, it proved to be an effective machine for removing fine pyritic sulfur from thickener underflows.

The machine, described by D. R. Mitchell and H. B. Charmbury, The Pennsylvania State University, State College, Pa., is easy to construct, and would have low maintenance in normal plant operation.

Social Events

Two luncheons and a banquet comprised the social segment of the conference. Each bore further testimony to the co-operation between Canada and the United States and to the gracious hospitality of the Canadian hosts.

Guest speaker at a business luncheon, on October 10, was Dr. C. Ouellet, dean of the faculty of science, Laval University, Quebec City. His talk, "All Problems Will Be Solved Tomorrow," was a satiric and witty representation of automation in the not-too-distant future. With tongue very-much-in-cheek, Dr. Ouellet said, "...the answer to our problems is a larger team with more specialized components. This again is beginning to look like another machine. In fact, a team is a machine, a large team is a factory."

High light of the conference was the banquet at which a message from the Honorable Paul Comtois, Canadian Minister of Mines and Technical Surveys was read by Deputy Minister Mark Boyer. The Minister reiterated the essential theme of the conference: "Coal will continue to be an important source of physical energy."

At the banquet also, Dr. Jean Bruchési, Under-Secretary of the Province of Quebec, delivered an address entitled "A Tale of Two Cities." His Canadian-American audience was treated to a humorous description of the traditional rivalry between two of Canada's major cities, Quebec and Montreal.

The banquet program was concluded with the appearance of a folk-dance group "Les Villageois." The dancers further emphasized the similarity of the traditions from which Canadians and Americans stem.

Percy Nicholls Award

Annually the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining, Metallurgical and Petroleum Engineers present the Percy Nicholls Award for achievement in the field of solid fuels. The 1957 recipient of the award was John Blizard, Fellow ASME, and director of research, Foster Wheeler Corporation, New York, N. Y. Mr. Blizard was cited for his contributions to advanced practice in fuel utilization and heat transfer and for the research he has directed on radiant superheaters, pulverizer design, twin-furnace and forced circulation steam generators and heat exchangers for oil refining. His concern for and encouragement of young engineers was also noted in the citation. Carroll Hardy, Mem. ASME, and director, market promotion department, National Coal Association, Washington, D. C., made the presentation at the banquet.

Women's Program

While there may have been many conferees who saw little more of Quebec City than the inside of the Chateau Frontenac, at least those who traveled with their wives received second-hand accounts of the wonders of Quebec City. Under the chairmanship of Mrs. G. Letendre, the ladies' activities included a scenic tour of upper and lower Quebec City. The ladies were able to glimpse aspects of rural life in Canada en route to such spots as Lac Beauport and Ste. Anne de Beaupré. Their activities were concluded with tea at the site of historic achievement, the Citadelle.

Conference Committees

The success of the conference can be attributed to the efforts of the several committees and their chairmen: T. S. Spicer, general chairman, Mem. ASME, and professor of fuel technology, Pennsylvania State University, State College, Pa.; H. B. Charmbury, Mem. AIME, head of the department of mineral preparation, Pennsylvania State University, State College, Pa., and A. O. Dufresne, Mem. CIM, deputy minister, Department of Mines, province of Quebec, Quebec City, Canada.

Availability List—1957 ASME-AIME Joint Fuels Conference Papers

The papers in this list are available in separate copy form until August 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57-FU-1	Sound Methods of Solid Fuel Evaluation, by E. D. Holdup
57-FU-2	Flow of Coal in Bins, by F. D. Cooper and J. R. Garvey
57-FU-3	Thermal Stabilization of Anthracite by Calcination, by J. W. Eckerd and R. F. Tenney

ASME Applied Mechanics Division Joins in ASA Mechanical Shock and Vibration Program

Recent action by the Applied Mechanics Division of The American Society of Mechanical Engineers promises to lead to participation by ASME in a program of the American Standards Association in the rapidly developing field of mechanical shock and vibration. The expanding activities of the ASA in this field have evolved from a program which was initially acoustical in nature. The increasing scope of vibration activities within the existing Sectional Committee Z24 made it desirable to appoint a Sectional Committee dealing entirely with shock and vibration standardization. This new Sectional Committee is identified as S-2, and is sponsored jointly by the Acoustical Society of America and ASME.

Principal Objective of Program

The principal objective of the program is to establish standards where this would assist in advancing the technology of shock and vibration. Standards now being prepared or contemplated cover many facets of the technology, including terminology, testing machines, measuring instruments, testing and calibration methods, and specifications for denoting significant characteristics of devices and materials. Still other topics are being explored for possible standards work. Continuing attention will be given by the new Sectional Committee S-2 to new technologies which are developing in shock and vibration programs to determine where standards of terminology, measuring methods, or basic concepts would be of assistance.

In addition to representatives of the two sponsors afore-mentioned, Sectional Committee S-2 includes a number of other voting members. The work of the Committee is carried out by several task groups having subcommittee status, subject to approval or disapproval by the voting members. The initial action for investigating a new topic is usually the formation of an exploratory group to investigate the general subject matter and make recommendations.

Steps Toward a Standard

If it is the recommendation of the exploratory group that a standard is feasible and desirable, a writing group is then appointed to carry out the writing of the standard. The following writing groups are currently in existence and functioning under the supervision of Sectional Committee S-2:

1 Revision of shock and vibration terminology for inclusion as a part of the general terminology for acoustics.

2 Shock testing machine for electronic components.

3 Variable duration lightweight shock testing machine.

4 Calibration of shock and vibration measuring instruments.

5 Auxiliary equipment for shock and vibration measurement.

6 Vibration testing machines.

7 Mechanical impedance of structures.

In addition to the preceding writing groups, the following topics are being studied by active exploratory groups with the objective of recommending future action:

1 Resilient mountings.

2 Techniques of vibration measurement.

3 Reduction of shock and vibration data.

4 Damping of materials.

5 Balancing.

As co-sponsor of Sectional Committee S-2, ASME is represented by two voting members. The representatives on the Committee, appointed by Chairman M. Hetényi of the Applied Mechanics Division, and confirmed by its Executive Committee on June 14, are: Charles E. Crede and D. C. Kennard, Jr.

Dynamic-Versus-Static Fuel-Control Testing a Controversy at Vickers Hydraulics Symposium

LIVELY debate on dynamic-versus-static testing developed during the jet-engine fuel-control session at the 1957 Turbojet Engine Hydraulics Symposium held by Vickers Incorporated in Detroit, Mich., at the Hotel Statler.

This followed a paper by J. Bigus, staff engineer, and R. Egge, group leader, Vickers Aero Hydraulics Division on the Vickers Dynamic Fuel-Control Test Stand. Discussion was both by panel and from the floor. A panel representing engine and control manufacturers and the Bureau of Aeronautics had A. J. Hess, Division Manager, Holley Carburetor Co., as moderator.

Advantages of dynamic testing pointed out include elimination of costly and time-consuming flight testing, elimination of replacements often found necessary with controls subjected only to static calibration, greatly reduced testing time, increased acceptance rate, better, more accurate calibration, and saving of fuel. By liberal use of automation, the Vickers Test Stand validly simulates flight conditions—saves the operator much time and trouble.

Floor discussion waxed hot, but the ultimate conclusion seemed to be that static testing requires too much time and money. One participant summed it up by saying: "It is certainly time to take a new and careful look at this whole subject of fuel-control testing."

High-Temperature Operation and Miniaturization Arouse Interest

Guests at the symposium also were decidedly interested in "smaller and hotter" hydraulic systems.

Extreme limitations on space and weight encountered in missile applications have brought a demand for miniaturized hydraulic systems. Heat from thermal barrier and from proximity to high-intensity combustion calls for hydraulic systems that will operate at temperatures never attempted before.

Vickers exhibited and described piston-type hydraulic pumps which have been operated successfully at 450 F for 200 hours. Pumps to operate at 550 F were said to be not more than six months away.

In the field of miniaturization, a number of very compact, lightweight components and systems were described and shown. Fixed displacement piston pumps, usable also as hydraulic motors, which deliver up to 5 hp per lb of weight, were exhibited.

Future developments in the field of systems to operate at extreme temperatures were treated by Gerhard Reethoff, Assoc. Mem. ASME, chief of research, Vickers Incorporated. He projected possible use of high-pressure gas, mercury, liquefied metals, and other fluids. He described an experimental position servo using hot gas at 2000 psi which showed a rise time of 4 millisec to a small step input signal. Solid propellant was used to generate the high-pressure gas. He also discussed possible use of hydrokinetic devices such as centrifugal pumps and pitot-type pumps.

In connection with high-temperature operation, representatives of chemical and research organizations discussed the progress made in hydraulic fluids to withstand the higher temperatures. Papers indicated that loss of lubricity is one of the most serious difficulties to be overcome.

Sessions were attended by 114 guests from United States, Canada, and Europe, and 52 Vickers people.

Chairman and speakers at session on "Engine Hydraulics Systems" at Vickers Turbojet Engine Hydraulics Symposium. ***Left to right,*** **seated, are: D. Moses, W. S. Bobier Jr., J. Woodward.** ***Standing:*** **D. E. Vehling, A. A. Pack, chairman, R. P. MacDonald.**

Many of the 114 guests from U. S., Canada, and Europe, and the 52 Vickers engineers who attended the 1957 Turbojet Engine Hydraulics Symposium, sponsored by Vickers Incorporated

ASME Coming Events

March 2–6, 1958
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–22, 1958
Nuclear Congress, International Amphitheater, Chicago, Ill. (ASME is cosponsor.)

March 17–20, 1958
ASME-ARS Joint Aviation Conference, Hotel Statler-Hilton, Dallas, Texas

March 19–20, 1958
ASME-AIEE Engineering Management Conference, Somerset Hotel, Boston, Mass.

March 30–April 1, 1958
ASME Wood Industries Conference, Syracuse University, Syracuse, N. Y.

April 1–3, 1958
ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10, 1958
ASME Railroad Conference, Hotel Statler, Cleveland, Ohio

April 14–15, 1958
ASME Plant Maintenance Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17, 1958
ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 15–17, 1958
ASME-AWS Metals Engineering Joint Conference, Hotel Statler, St. Louis, Mo.

pril 24–25, 1958
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.

May 18–22, 1958
ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 11–14, 1958
Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is cosponsor.)

June 15–19, 1958
ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Aug. 18–21, 1958
ASME-AIChE Heat Transfer Conference, Northwestern University, Evanston, Ill.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(For Meetings of Other Societies, see page 1189)

Program taking shape for the

1958 NUCLEAR CONGRESS

to be held March 17–21, 1958, at the International Amphitheater, Chicago, Ill.

Over thirty engineering and scientific societies are completing plans for the 4th Nuclear Engineering and Science Conference, to be held at the Chicago International Amphitheater, March 17–21, 1958.

Inspection trips are planned to the Argonne National Laboratory and to the Dresden Nuclear Power Station, which will be under construction.

Developments in atomic energy will be presented in the 200 papers expected for the technical sessions from the standpoint of engineers, physicists, metallurgists, and chemists. The program committee for the Nuclear Engineering and Science Congress plans to have eight parallel sessions daily, with six papers each, with the Hot Laboratories Committee presenting an additional 50 papers on Thursday and Friday.

Among the reactor concepts to be dealt with will be the Liquid Metal Fuel Reactor Experiment, reactors for aircraft propulsion including a nuclear-powered turbojet, and a high-temperature gas-cycle reactor steam plant, the evaporative-cooled reactor, variable-moderator-controlled reactor, the Armour dust-fueled reactor, the sodium-cooled heavy-water-moderated reactor, and the high-power intermediate-enrichment pool reactor.

Other sessions will deal with reactor component development, fabrication, and testing; reactors for process heat and radiation, as well as the many problems involved in fuel processing, thermal and mechanical design, operation, maintenance, and instrumentation of reactors.

There will be special sessions on the commercial use of radioactive tracers, as well as the production and miscellaneous applications of radioisotopes; health physics and instrumentation, reactor location and safety, waste disposal, water contamination, and treatment.

The National Industrial Conference Board and the Atomic Industrial Forum, Inc., will jointly sponsor an Atomic Energy Management Conference which will be part of the Congress. This annual conference provides management with a comprehensive review of world-wide progress in the development of low-cost nuclear power and other industrial uses of atomic energy.

The Atomic Industrial Forum's "Atomfair" will be held in conjunction with the technical sessions, and will display the latest developments in industrial uses of atomic energy.

Preprints of papers will be available well in advance of the Congress and may be ordered from the Advance Program which will be distributed in January. Copies of the program should be requested from the Secretary, ASME.

ASME Codes and Standards Workshop

New Drafting Standards Manual

According to an article by R. P. Hoelscher, Mem. ASME and chairman, Sectional Committee Y 14, American Standards Association, in the *Magazine of Standards*, the ink of the 1946 revision of our drafting standard was scarcely dry when another revision was called for in the spring of 1948 by the Company Member Conference of the American Standards Association.

Committee Reorganized

In November of 1948, the Sectional

Committee Y14, formerly Z14, was reorganized, an Executive Committee appointed, and a chairman elected. By the spring of 1949, a program of revision had been outlined and work was well under way in selecting chairmen and members of subcommittees to carry on the actual work of revision. Since the sectional committee is large, the Executive Committee was assigned the task of carrying on the details of operation.

The revision, which is now nearing completion, covers all of the material contained in the 1946 edition with some changes as described in later paragraphs.

It goes much farther, however, into areas not previously covered. This new document, or more correctly, series of documents, is far more detailed and much more extensive than previous editions.

More than 168 men plus 11 men on the executive committee have been engaged over a period of nine years in producing the seventeen sections of this standard.

Not one of the sections was completed in under less than two years of planning, criticism, debate, and careful study of all points of view expressed by any person or company interested enough to send in comments. One section, namely No. 5, on the subject of Dimensioning and Notes, was under active and vigorous discussion for almost eight years before a consensus was established.

Uses of the Standard

Company standards. For the standards engineer, engaged in revising his own company drawing standard, the new American Standard Y14 Drawing Manual will provide excellent source material of authoritative methods and practices approved by literally hundreds of industries and professional engineering societies.

The U. S. Department of Defense has co-operated closely in the development of this new standard, and it seems likely that there will be little difference in the major features of Military Standards and the new American Standard.

If a company is setting up a new standard for drawing practices for the first time, the applicable sections of the new Y14 drawing standard provides the best starting point. For a small drawing group in a company without a definitely established standards department, and perhaps with little or no time to prepare a drawing standard, no better nor more economical practice could be devised than to adopt the new standard in toto or such sections of it as apply to the business of the company.

In keeping with the fundamental philosophy of standardization, namely, that of securing greater economy in manufacturing operations, the new drafting standard has been developed with this objective constantly in mind.

It was also necessary to keep in mind that drawings are more and more becoming the basis of legal contracts.

Their intent must, therefore, be unmistakable and unequivocal. Simplification of drafting standards has, therefore, been limited to those areas where a national consensus now exists.

This program does not go as far as some persons would like, but the committee believes it has gone as far in drafting simplification as it is prudent to go at the present time. In subsequent revisions it may be possible to introduce further simplification as some of these practices become more thoroughly understood and more universally accepted.

Company training programs. Since the various sections of the Drafting Manual will be issued separately, they can be used to supplement company standards where the latter do not provide as thorough coverage as may be desired for training programs for draftsmen. In this respect, Sections 7 through 17 will be found very useful not only in training but for draftsmen and young engineers who must translate the ideas of designers into working drawings.

For companies contemplating the development of training programs and not having adequate standards of their own, the new American Drafting Standards Manual can be adopted as a correct and adequate guide for their trainees.

Educational institutions. Drawing departments of Engineering Colleges and Technical Institutes will find in this new standard authoritative guidance for instruction. While it cannot be said that the drafting standard will settle all problems which arise in the teaching situation, it will answer most of them and reduce the area of doubt by a very substantial amount. By following the standard, students will have a sound

Delegates and observers to the A-B-C Conference. *Left to right,* front row: J. G. Morrow, Canada; G. F. Hussey, Jr., Mem. ASME, U. S.; T. R. Houston, U. K.; A. N. Huddleston, Canada; R. P. Hoelscher, Mem. ASME, U. S.; S. J. Harley, U. K. In back, *left to right:* C. L. Miller, U. S.; Frank Harley, Canada; C. H. Heller, U. S.; C. E. Hilton, U. S.; Leon DeMause, U. S.; Stanley Parker, U. K.; Harry Springer, U. S.; Frank Philippbar, Mem. ASME, U. S.; G. Moes, Canada; B. N. Orr, U. S.; R. S. Paffenbarger, Mem. ASME, U. S.; R. P. Trowbridge, Mem. ASME, U. S.; C. C. Muller, U. S.; E. M. Bagley, U. K.; F. D. Floto, U. S.; William Charlson, U. K.; Craig Telfer, Mem. ASME, U. S.; E. H. Jones, U. S.; S. H. Watson, U. S.; J. W. McNair, U. S.; Kenneth Joy, Canada; Joseph Stannard, U. S.; A. Moline, Mem. ASME, Canada; J. H. Shields, Canada; C. McMahon, U. S.; J. D. Wilding, Mem. ASME, U. S.; George Noble, Canada; C. H. Springer, U. S.; Norman Brown, U. S.; P. G. Belitsos, U. S.; S. C. Miller, U. S.; C. H. Agar, U. K.; Frank Smith, U. S.

Chairmen of the delegations of Great Britain, Canada, and the United States to the Conference on Drawing Practice: T. R. Houston, English Electric Company; Lt. Col. A. N. Huddleston, Canadian Ministry of Defense; and Professor R. P. Hoelscher, Mem. ASME, University of Illinois

basic knowledge to enter any phase of drafting covered by the manual. By having direct access to this standard for reference, students will also become more familiar with the work of the American Standards Association and know where to look for help in other areas where standards can save money. Complete copies of the standard should be available to students for reference while taking their drawing courses, since it will no longer be possible for textbooks to reproduce the entire drafting standard which will run close to 300 pages.

(Sections 1, 2, 4, and 5 have been approved by ASA and are available from the ASME Order Dept. Other sections are expected shortly.)

Conference on Drawing Practice

APPROVAL by Sectional Committee Y14 of Sections of the American Drafting Standards Manual, covering basic material on: Size and Format, Line Conventions, Sectioning and Lettering Pictorial Drawing, and Dimensioning and Notes, enabled an American-British-Canadian Conference to be called to study unification of the drawing standards of the three countries. The conference was held in Toronto, Canada, October 7–11, 1957

American-British-Canadian Conference

It was found that substantial agreement already existed among the three standards. Revisions, relatively minor in nature, were developed for recommendation to the respective national standards groups. In addition, a comparison chart was prepared showing the differences in expressing the same intent in the three standards.

The following statement was made at the conclusion of the conference by the chairman, Lt. Col. A. N. Huddleston, of Canada:

"Delegates from America-Britain-Canada at Toronto have examined and considered the respective publications of these national standards bodies relating to engineering drawing practices, namely, American Standards Association Y14, 1–6; British Standards BS308; and Canadian Standards Association, B78.1.

"The delegates have propounded recommendations, the implementation of which will eliminate any significant difference in principle so that drawings prepared in accordance with any one of these standards, when amended, will be capable of being readily understood and used in the factories of the countries.

"This is the successful culmination of a project which has been patiently pursued for some twelve years.

"The result will greatly facilitate exchange and mutual understanding of designs and manufacturing data amongst the countries concerned, and eliminate the necessity for preparation of fresh drawings. By providing designers with a common language, the results of this session should lead to lower costs and improved security. In a state of emergency, it will permit the assignment of component manufacture among the three countries, to take full advantage of their manufacturing facilities, and so achieve maximum production."

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

What Can the Young Engineer Do to Develop Professionally?

Warren R. Thompson[2]

THIS theme is essentially the same one that the National Junior Committee has been following in its meetings and discussions for the past few years. A wealth of information has been delivered on this theme, and yet it is a theme that is of continuing interest and has many implications to the young engineer. Some of these implications are overlooked entirely, or at best, not understood completely. Our theme leads us immediately to three propositions:

1 The young engineer is deficient in many respects in his engineering background.

2 The young engineer is capable of doing something to enhance his career.

3 The young engineer is willing to undertake this something that is called professional development.

You may say that these three propositions do not need reiteration, but in the work of the National Junior Com-

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

[2] Chairman, National Junior Committee, Philadelphia, Pa.

mittee we have found, with an all too great a frequency, that the young engineers ready to graduate from school and those entering into the industrial world do not have a clear concept of what a truly professional career means. Many of these young engineers take for granted that a professional career will come in due time without any particular effort on their part. All they have to do is wait for the promotions and salary increases, do the work assigned to them in the manner dictated by their bosses, and not ask too many questions. When the awakening occurs they find themselves classified as technicians, their morale deteriorates, and they start to look for a "better job." Perhaps these remarks will prevent some of those unfortunate situations.

First Proposition

The first proposition presented states that the young engineer is deficient in many respects in his engineering background. If we read the reports of the American Society of Engineering Education, the reports of the Engineers' Council for Professional Development, and look at the numerous industrial training programs, we find that this is true. We recognize this fact in our own professional careers. Yet, how many recent college graduates recognize the fact that they do not have a well-rounded engineering background?

The young engineer has worked a multitude of classical problems in thermodynamics, heat transfer, alternating-current circuits, structures, and so on. These problems are of necessity simplified and serve to illustrate a fundamental concept. They bear enough resemblance to real devices to enable the young engineer to recognize them, yet the real devices impose requirements beyond the school problem. How many young engineers are made aware of this difference?

Thus we arrive at the first thing the young engineer must do if he is to develop professionally. He must carefully review his educational background and the requirements of the industry he has chosen and determine those areas where his technical knowledge is deficient.

Second Proposition

Our second proposition is that the young engineer is capable of doing something about his career. The old adage, "Know Thyself," applies most aptly to the engineering profession. We deal with the laws of nature and they require the best in each of us. For us to serve this uncompromising taskmaster we must know the limits of our abilities. Honest self-criticism on what we can or cannot do, like or dislike about engineering will enable us to know our capabilities and allows us to direct our energies into the most profitable channels.

Third Proposition

The third proposition concerning the desire for professional development suggests an approach which is a demanding one, an approach that requires inspiration and dedication. It is like the story of two young engineers both of whom were assigned the task of designing a journal bearing. One of them attacked the problem as a chore, while the other looked upon the problem as an intriguing assignment leading to the study of bearing metallurgy and lubrication. Professional development requires that a person increase his fund of specialized knowledge, that he learn to conduct his affairs with the utmost in honesty and integrity, that he participate in public affairs, that he actively support his professional society, that he constantly strive for more effective utilization of our resources, and that he know, understand, believe, and practice the Canons of Ethics for Engineers.

Goals of Professional Development

Let us now consider the goals of professional development in terms of various levels of engineering work and analyze them accordingly. The first level of engineering work is the level of technical competence where it is possible to predict the answer to a given problem through the application of physical laws and known data. This is the level of engineering work available to the young engineer when he graduates from school.

The second level of engineering work is the level of technical judgment where only a portion of the problem can be solved through the use of physical laws and known data. At this level, mature experience is required, experience gained through personal efforts and the study of the successes and failures of others. Here, the final decision is made after exhausting all known facts and considering the various judgment factors to which no quantitative value can be assigned. The engineers at this level must be willing to take the risks involved for each decision they make.

The third level of engineering work is the policy-making level where questions of size and location of physical plant, sales, costs, level of investment, timing of efforts, size of labor forces, and similar problems must be answered. This is the level of the top executives in industry.

These three levels of attainment are also related to our three basic propositions. The first proposition which raises the question of technical competency, is one that must be solved at the first level of engineering work. It is only by a thorough mastery of the scientific fundamentals that the young engineer can ever hope to be qualified to move on to more important positions. The second proposition, which raises the question of capability, is a prerequisite for the higher levels of engineering work and responsibility. The third proposition, that of inspiration or motivation, is the driving force needed in the young engineer for him to reach the second and third levels of engineering work.

The young engineer now might well ask: "This is fine, but how does it affect me? What do I have to do?" These are legitimate questions, questions that must be answered when talking about "Professional Development." Given normal capability and interest, the young engineer wants to know the specific steps he must take to move upwards in his company to more responsible positions and better pay. Once again, referring to the work of the National Junior Committee, we have found some specific items for the answers to these questions. The answers are by no means unique. They are a reiteration of the thoughts and wise counsel of many men, but they are basic and cannot be repeated too frequently.

What Young Engineers Should Do

The young engineer should bear in mind that one of the most precious possessions he can have is the ability to reason and think logically. The following items are specific to the extent that they will show a definite course of action, yet broad enough to allow for individual planning. To bring these items to life and give them meaning he must reason each one carefully and try to anticipate the probable consequences of his plan of action. His plan of action should be reviewed periodically and revised if necessary in the light of changed circumstances. Thus he will find that he can keep abreast of or even ahead of his job requirements so that when opportunity presents itself he can take advantage of it.

The first item the young engineer should undertake is an inventory of his educational background and the technical requirements of the industry he has

chosen. He should then, knowing those areas of particular interest to him, map out a program of technical study to meet the deficiencies encountered. This program of study can be formal, at the graduate level in school, or informal, at home or in the office. The important thing is to recognize that additional study is needed.

Concurrently with additional study, the young engineer should join and become active in his professional society. Here he will receive the obvious benefit of hearing papers on various subjects, but above this obvious benefit he should help in the many tasks that need to be done. He can learn to meet and work with people of different ideas and persuasions. He can, in the inevitable "bull sessions" that occur at every meeting, learn of the ways other companies do business, their policies and goals, their requirements on equipment and operating procedures, and add these to his fund of knowledge and experience.

The young engineer should, early in his career, become active in church work and civic affairs. These groups need the specialized talents of the engineer for their proper functioning, but just as important, the engineer needs these groups. Here he will come in contact with people who know little or nothing about engineering and scientific matters, yet he will have to work with them. He will learn of their ideas and in turn will have to sell his own. Here is the place where the young engineer will learn that cold logic and obvious facts are sometimes not sufficient to swing people to his point of view; that many times ethics, and morals, and emotions are the controlling factors in persuading an individual to act. This kind of training is invaluable as an example, when called upon to sit on grievance committees, or participate in union contract negotiations. I recall an instance where just such an understanding of human nature was able to solve a difficult production problem. Dr. Lillian M. Gilbreth, Hon. Mem. ASME, in an address before the Philadelphia Section of the ASME, related how she was called into a manufacturing plant to study their production methods. She eventually submitted her report with recommendations for improvement. To her consternation the benefits were not realized and she tried to find the reason. After careful study she located the trouble at the station of a woman who had been highly efficient before in her repetitive assembly work. Even though her task had been simplified, she was turning out less work. Why? The woman liked to dance and her previous tasks were to the tempo of a good fox-trot. Her new tasks, while simpler, were at a different tempo and she became very frustrated without knowing the reason. Dr. Gilbreth, after timing the tempo carefully, suggested that the woman waltz instead of fox-trot. With a cautious experiment, the woman smiled, and started to waltz through her repetitive work. A simple solution, isn't it, but a solution that required a keen insight into human nature.

As a fourth item, the young engineer should begin to develop interests in fields other than engineering; interests in the fields of literature, philosophy, art, music, sports, or any of the hundred and one other possible fields. Here he meets with the ideas and ideals of great men both past and present, and can make their experience a part of his own. Here he begins to appreciate the great contributions of science and technology and can place his own contribution into a proper perspective.

As a final item, the young engineer should eventually study the methods and techniques of program planning, where program planning is defined as the problem of delivering a finished product, at a reasonable cost, by a given date. Here the young engineer learns to answer the questions of what must be done, and when, in research, engineering, purchasing, manufacturing, assembly, and testing. How many men of what qualifications are going to be needed and when will their services be required? What are the anticipated money requirements for each week or month of the project, and where can it be obtained? What about shop space and tools—do we have them or do we rent or buy? These are the problems of the top men in industry, and their solution requires long training and mature experience and judgment.

This list is brief; it contains but five items. Within each item there is an almost unlimited field of endeavor so that the young engineer, when following his program of professional development, need never remain static. As he grows technically and professionally he will find new areas opening up for investigation and study. New developments will require careful study and evaluation and eventually, a decision on their desirability. Thus we have a lifetime of study and work regardless of the level of engineering responsibility attained.

I have tried to define a problem, give meaning to the terms used, and point to a direction of travel. I admit that this program may not be universally applicable in all its aspects since the capabilities of each man and his desires and aspirations are so different from those of any other man. Regardless of the level of engineering work reached, however, it is important and necessary for each of us, in our careers, to incorporate the full meaning of professional development into our daily activities. It will make our jobs easier and more productive and will give each of us the satisfaction of a job well done.

Open Letter to Junior Forum

I WOULD like to answer Mr. A. W. Peev's letter which appeared in the September, 1957, issue of Junior Forum, on page 908.

I agree heartily that more thought should be given to the problems of small private enterprise. We owe it to next year's engineering graduates to give them an insight into conditions affecting their future. For example, an engineering student should try to determine in his own mind whether he wants to work for someone else or work for himself. This is even more important than whether he studies to become a mechanical engineer or an electrical engineer, and so on. However, most students never even hear this side of the story.

Our company was started one year ago this month. We have been fortunate in receiving consulting work from both large and small concerns as well as an R&D contract from the U. S. Government.

However, we have received enough refusals to the offer of our services to convince us that there is no real engineering shortage. The only shortage now is an age-old shortage, a genius who will work for $2 per hour and who doesn't care where he has to live.

With regard to finances, it appears to us that the banks couldn't be less interested. They will lend on accounts receivable but they won't finance any risks. We have seen other engineers try to build up a business by working evenings while keeping their regular positions. This has not been successful in the cases we know. Our company got started with no prospects and one full-time engineer; four months elapsed before the first customer's check was received. It cost about $100 a week to maintain a consulting office, part-time secretary, advertise, and the like.

This adds up to $1700 out of pocket and one third of a year's salary unearned totaling approximately $5000. I reiterate, we have been lucky and it was worth every cent of it.

Each person has to try it for himself

and see. There will be few regrets and a great deal of work—but don't try it unless you can afford to wait at least six months for the first job.

G. W. Bishop.[3]

State Boards for Engineering Registration. The following completes the listing of State Boards of Professional Registration.

Rhode Island State Board of Registration for Professional Engineers and Land Surveyors, P. S. Mancini, secretary, 246 State Office Bldg., Providence, R. I.

South Carolina State Board of Engineering Examiners, T. Keith Legaré, secretary, P. O. Drawer 1404, Columbia, S. C.

South Dakota State Board of Engineering and Architectural Examiners, E. D. Dake, secretary, S. D. School of Mines and Technology, Rapid City, S. Dak.

Tennessee State Board of Architectural and Engineering Examiners, Granbery Jackson, Jr., secretary, 503 Nashville Trust Bldg., Nashville, Tenn.

Texas State Board of Registration for Professional Engineers, C. L. Svensen, executive secretary, 308 W. 15th St., Austin 1, Texas.

Utah Professional Engineers and Land Surveyors Examining Committee, Dept. of Business Regulation, F. E. Lees, director, 324 State Capitol Bldg., Salt Lake City, Utah.

Vermont State Board of Registration for Professional Engineers, W. D. Emerson, secretary, Norwich University, Northfield, Vt.

Virginia State Board for the Examination and Certification of Professional Engineers, Architects and Land Surveyors, T. N. Burton, secretary, P. O. Box 1-X, Richmond, Va.

Washington State Board of Engineering Examiners, E. C. Dohm, secretary, Department of Licenses, Professional Division, Transportation Bldg., Olympia, Wash.

West Virginia State Registration Board for Professional Engineers, Robert Williamson, Jr., secretary, 301 Morrison Bldg., Charleston, W. Va.

Wisconsin State Registration Board of Architects and Professional Engineers, W. A. Piper, secretary, 1140 State Office Bldg., Madison 2, Wis.

Wyoming State Board of Examining Engineers, Mrs. W. H. Lang, assistant secretary, 201 State Capitol Bldg., Cheyenne, Wyo.

[3] Bishop Engineering Company.

ASME Elects Six to Grade of Fellow

The American Society of Mechanical Engineers has honored six of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

Harold C. R. Carlson

Harold C. R. Carlson, president and chief consulting engineer of The Carlson Company, and president of the Carlco Corporation, New York, N. Y., has made valuable contributions to the advancement of engineering in machine design, the spring-manufacturing industry, and as a consulting engineer. He was a design engineer for the Otis Elevator Company for 12 years; chief engineer of the Lee Spring Company for five years; manager and chief engineer, The Fischer Company for two years; and has been in private practice since 1948. His consulting practice covers industrial management, machine design, development of mechanical products, plant layout, production methods, and similar activities. He specializes to a certain extent in work for the spring-manufacturing and wire-forming industry, and holds patents on spring coilers, spring testers, grinders, torque-testing instruments, and other products. He is the author of over a dozen technical papers on spring manufacture and other subjects, and of the Spring Design Section of "The Tool Engineers Handbook." A partial listing of his activities in the ASME include: chairman, Metropolitan Section, 1943; chairman, Metropolitan Section, Machine Design Division, 1944-1952; and director and member of the Council, 1954 to date. In addition, he was the founder and first president of the Technical Societies Council of New York in 1946; chairman of the Engineering Societies Committee on War Production of New York in 1944, and chairman of the American Society for Testing Materials, New York District, from 1950 to 1952. He is a licensed engineer in the State of New York, a director of the New York Chapter of Professional Engineers, and a recipient of many honors including membership in Pi Tau Sigma.

Huber O. Croft

Huber O. Croft, dean of engineering, University of Missouri, Columbia, Mo., has made wide contributions to the engineering profession both as a writer and as a professor. His academic career began in 1922, when he was appointed assistant professor of mechanical engineering at the University of Illinois. In 1927, he transferred to Stanford University where he became an associate professor of mechanical engineering. He was a professor and head of the department of mechanical engineering at the University of Iowa from 1929 to 1949. He has been dean of the college of engineering and director of the Experimental Station at the University of Missouri from 1949 to date. He did practical engineering work with the City of St. Louis, Mo., the Public Service Company of Northern Illinois, and the Murray Iron Works. He has published numerous technical articles and papers for technical journals and contributed 40 sections on "Steam Boilers," "Steam Engines," and "Foundations" (Power Plant Series, edited by Terrel Croft, McGraw-Hill Book Company), and is the author of "Thermodynamics, Fluid Flow, and Heat Transmission." His activities on behalf of the Society have been varied. In 1934 he attended the Engineering Conference in Mexico City as ASME representative. He was a member of the Committee on Industrial Instruments in 1937; a manager of the Society from 1941 to 1943; member of the Nominating Committee from 1946 to 1947. He also holds membership in the New York Academy of Science, the American Society of Heating and Ventilating Engineers, and is a Fellow of the Royal Society of Arts, London. In 1946, he was president of the American Society for Engineering Education (formerly the Society for the Promotion of Engineering Education). He has served as a consultant for the U. S. Army Ordnance Department, Aberdeen, Md., in 1943; the American Council on Education in 1944; the Bush-Bowman Committee on Post-War Research, and U. S. Atomic Energy Commission from 1947 to 1950. In 1950,

on the basis of his "outstanding achievements in the fields of science and international understanding," the French Republic awarded him the Certificate of Award of the decoration, "Officier d' Académie."

Paul Smith Dickey

PAUL SMITH DICKEY, president of the Bailey Meter Company, Cleveland, Ohio, has made substantial contributions in several fields of engineering. His long career with the Bailey Meter Company began in 1925. In his work as a sales-service engineer with that company he was active in research and design work on steam-generating equipment, as well as on problems involved with measurements affecting their operation. As a research engineer and director of research in the 1930's he was instrumental in the introduction of many new meters and in the creation of the equipment and operating concepts which resulted in a complete automatic control system. In 1940 he became chief engineer, and in 1948 he was made vice-president in charge of engineering, a position which he held until 1955 when he became president and director. Increased involvement with administrative duties has not prevented him from making personal contributions to the field of control of power generation in addition to inspiring the work of others. This is attested to by the fact that in addition to the 60 patents which he now holds, there are numerous pending applications for steam-temperature control, pneumatic control systems, and furnace control. He is the author of several articles which appeared in technical publications. He has served the ASME on a local and national level. He has been a member of the Power Test Codes Committee No. 19 since 1950, and has been chairman of the Finance Subcommittee of the ASME Fluid Meters Committee since 1950. He is a registered engineer in the State of Ohio.

William L. H. Doyle

WILLIAM LEONARD HUNT DOYLE, assistant director, research department, Caterpillar Tractor Company, Peoria, Ill., has made significant contributions in the field of diesel engine research and engineering. Mr. Doyle's career with four of the leading diesel-engine manufacturing firms spans the era during which substantially all important diesel-engine developments have occurred. His eminence and proficiency in this field doing individual work and team work are exemplary in the following two classes of endeavor, namely, supercharging of diesels and engineering standardization. In the field of Standards and Codes his pioneering and active participation are best exemplified by these codes published or soon to be published. These are efforts performed through ASME committees and the names of the "acceptance-type" codes are as follows: "Power Test Code for Speed-Governing Systems of Internal-Combustion Engine-Generator Units," "Power Test Code for Speed-Governing Systems for Steam Turbine-Generator Units," "Recommended Specifications for the Speed Governing of Internal-Combustion Engine-Generator Units." In addition to his work on the ASME Power Test Code Committee No. 17 on "Power Test Code for Internal-Combustion Engines," on which he has served both as a member and secretary from 1943 to date, he also has served the Society on several other committees. He was active on the Oil and Gas Power Division Executive Committee as a member from 1941 to 1944; chairman from 1944 to 1945; and as an associate member from 1946 to date. From 1946 to 1950 he was a member of the Professional Divisions Committee and he served as its chairman from 1950 to 1951. He has been a member of the Power Test Codes Committee since 1948. From 1949 to date he has been chairman of the Joint AIEE-ASME, subcommittee on "Recommended Specifications for the Speed-Governing of Internal-Combustion Engine-Generator Units." He is the author of several papers presented before the ASME Oil and Gas Power Division and others published in the technical press. He holds patents assigned to the Baldwin-Southwark Corporation and to the Caterpillar Tractor Company.

W. L. H. Doyle received certificate of promotion to grade of Fellow ASME at the Oil and Gas Power Conference, held in Louisville, Ky., May 20–23. *Left to right* are: P. B. Jackson, chairman OGP Division; Mr. Doyle; Lee Schneitter, OGP Lecturer; A. S. Hawks, recipient of an OGP citation for outstanding services; and G. J. Dashefsky congratulating Mr. Doyle on his promotion.

Clarence C. Franck, Sr.

CLARENCE CHRISTIAN FRANCK, SR., consulting engineer, Steam Division, Westinghouse Electric Corporation, Lester, Pa., has contributed much of the engineering direction which has accompanied and made possible the growth in alternate unit rating and improvement in thermal economy of steam turbines during the last 20 years. His long association with the Westinghouse Electric Corporation began in 1928 as a junior engineer. Since that time he has held such positions as design engineer, supervisor, manager, and was appointed to his present position as consulting engineer in August, 1956. Mr. Franck has been active in the ASME on both the national and local levels. As a member of The Johns Hopkins University ASME Student Branch, Mr. Franck was awarded the 1928 National Student Prize for his paper on "Condition Curves and Reheat Factors." He is a past-chairman of the Philadelphia Section and is currently a member of the Advisory Committee of Region III. He is a member of the Standing Committee of

the Power Test Codes Committee and chairman of Committee No. 6 on Steam Turbines as well as a member of the ASME Research Committee on High Temperature Steam Generation. He is a member of the Research Committee on the Properties of Steam and of the International Electrotechnical Commission Technical Committee No. 5 on Steam Turbines. He is the author of a number of publications and holds many patents in the turbine field.

Reginald E. Gillmor

REGINALD E. GILLMOR, recognized for his leadership in the field of management and management development, with Elmer A. Sperry contributed to the development and introduction of the gyro compass. In 1913 he introduced the gyro compass to England and established The Sperry Gyroscope Company Limited.

World War I interrupted his services as managing director of that company, and Mr. Gillmor entered the U. S. Navy. For his services with the American Naval Mission he was awarded a citation with Silver Star. After the war he returned to the United States to organize the Sperry Gyroscope Company on a peacetime basis. He successively held positions with that company as Washington, D. C., representative, sales manager, vice-president, and president, and then in 1946 as vice-president of the parent body, the Sperry Gyroscope Corporation. Mr. Gillmor was loaned to the State Department as Industry Director of the American Mission to Greece from August, 1947 to June, 1948. In September, 1948, he was appointed vice-chairman of the National Security Resources Board. He was appointed to the Special Task Force Committee on the Maritime Commission in 1952, and was appointed as Chairman of Interagency Distressed Defense Areas Task Force. In 1953 as a member of the Task Force appointed by President Eisenhower, he again visited Greece to survey the work of the American Mission there. Mr. Gillmor has often been sought to address numerous groups in engineering, industrial, and educational fields. Many of his addresses have been printed and given wide circulation, among which are: "The Creative Mind and Victory," and "The Ultimate Science." The Society awarded him the Melville Medal in 1948 for his paper "The World the Manager Lives In." He is also the recipient of the Scott Gold Medal "for distinguished service in the advancement of industrial preparedness . . ." In addition to his services as a trustee of four educational institutions: Barnard College, Webb Institute of Naval Architecture, Hampton Institute, and Adelphi College; he has served on many boards and committees; he has been a director of the National Industrial Conference Board, the Brooklyn Chamber of Commerce, and the Scientific Apparatus Makers of America.

NOMINATIONS OPEN: 1959 ASME OFFICERS

Regional Nominating Subcommittee In Each Region Has been Organized

THE 1958 National Nominating Committee of The American Society of Mechanical Engineers, charged with the responsibility of locating eminent leaders for the offices of the Society to be elected by the members for 1959, urges action on the part of the membership. They wish to stress the importance of giving early thought to the matter of searching out qualified individuals to serve as officers of the Society.

Each Section has been requested to appoint a member to assist the Regional Representative on the National Nominating Committee. These Section representatives will be charged with the responsibility of seeking from their Section's membership, qualified candidates. They will focus their attention upon this vital and important matter.

Names and addresses of the Representatives and the first and second alternates of the 1958 National Nominating Committee were published on pages 821 and 822 of the August, 1957, issue of MECHANICAL ENGINEERING. It is your obligation, privilege, and responsibility as well as that of every other member of the Society to assist the National Committee in obtaining the best men available. You can do your part by acting as a sponsor for those members who have the acknowledged qualities of outstanding ability and leadership in their profession.

Offices to be Filled for 1959

President	To serve 1 Year
Vice-President-Region II	To serve 2 Years
Vice-President-Region IV	To serve 2 Years
Vice-President-Region VI	To serve 2 Years
Vice-President-Region VIII	To serve 2 Years
Director (Technological) (1)	To serve 4 Years
Director (Administrative) (1)	To serve 4 Years

There must be no apathy and casualness associated with this responsibility, we must unite in our efforts to perform a better job.

The Committee believes that the Sections and the groups on Technology, Codes and Standards, and Administration have an abundance of qualified individuals who are ready and able to serve the Society as President, Vice-President, or Director. The Boards, Committees, and Professional Divisions make their recommendations through nominating conferences provided for in the Constitution, By-Laws, and Rules of the Society.

Nominations for ASME Honors Sought

MEMBERS and agencies of The American Society of Mechanical Engineers including Boards, Committees, Sections, and Professional Divisions are invited to submit nominations for Society honors and awards as described in the ASME Honors Manual MS-71. Nominations for 1958 must be in the hands of the Board of Honors prior to March 1, 1958.

As important changes have been made in the nominating procedures and the Manual, it is *essential* that those wishing to make a nomination secure a copy of the Honors Manual dated October, 1956, by writing to the Board of Honors, ASME, 29 West 39th Street, New York 18, N. Y. Please note carefully information given on pages 3, 6, 9, 10, 11, 12, and Appendix I for the major changes adopted by the Council.

These conferences will be called by responsible Board Chairmen in a letter to the chairmen of all committees under the respective jurisdiction.

You may, therefore, make your nomination through your group's representative, or directly through Charles A. Davis, Secretary of the 1958 Nominating Committee, Deere & Company, 1325 Third Avenue, Moline, Ill.

Your nomination must be on forms which can be obtained from members of the Nominating Committee, as well as the New York headquarters office.

ASME Council Actions on 1957 National Agenda Reported

How the National Agenda Is Compiled for Regional Administrative Committees and Items Which Are Ultimately Acted Upon by Regional Delegates Conference

At a meeting of the Executive Committee of the Council of The American Society of Mechanical Engineers, held at Society Headquarters, New York, N. Y., on Oct. 4, 1957, approval was voted of statements and actions on the recommendations of the 1957 Regional Delegates Conference submitted to the Council at the 1957 Semi-Annual Meeting, San Francisco, Calif., June 10, 1957.

These recommendations, the actions of the Regional Delegates Conference on them, and the actions or statements of the Council are reported in what follows. A detailed description of the procedure by which agenda items are prepared and acted upon by the Sections, the Regional Administrative Committees, the Regional Delegates Conference, and, finally, the Council follows the report on the 1957 recommendations.

Final Report on 1957 RDC Recommendations

Agenda Topic No. 53A: Council appoint committee to investigate group disability insurance. It is proposed that Council appoint a committee to investigate a suitable group disability and hospitalization insurance plan to cover the membership of ASME on an individual optional basis for presentation to the membership.

Delegates' Action: APPROVED 15 to 0

Council Action: Messrs. E. J. Kates, Chairman, V. Weaver Smith, and G. B. Warren were appointed by President Ryan on August 9, and the first meeting of this committee was held in Hartford, Conn., on Sept. 24, 1957.

Agenda Topic 52B: Change various operating years of the Society: It is proposed that the Regional year, including the term of office of the Regional Vice-Presidents and other officers, and committees of the Regions be changed to coincide with the Section year and Student Section year which now begins July 1st.

Delegates' Action: APPROVED 9 to 6

Council Action: The Council on Sept. 6, 1957 (#245) accepted the recommendation of the Organization Committee that no basic change be made in the operating years of the Society; and adopted the Vice-Presidents' recommendation to modify the Regional Operation Manual, ML-12, to strengthen the co-ordination of the incumbent Vice-President and the Vice-President Nominee in the matter of selecting committees which subsequently work with the latter.

Agenda Topic No. 7: Section Chairman be notified of honor awards: It is proposed that the Section Chairman be notified by Headquarters of an ASME honor or award bestowed upon or the appointment to a National Committee of a member of that Section by Headquarters.

Delegates' Action: APPROVED 15 to 0

Council Action: Does not require Council action. The Secretary's Office is complying with the voted action of the Regional Delegates Conference.

Agenda Topic No. 28: ASME guide for Section participation in National Engineers' Week: It is proposed that ASME formulate a policy to guide the Sections with respect to their participation in National Engineers' Week.

Delegates' Action: APPROVED 9 to 5

Council Action: Does not require Council action. The Secretary's office is including a statement in the Sections Operation Manual, ML-10.

Agenda Topic No. 29: Definition of Sub-Section boundaries be changed: It is proposed that the definition of boundaries for the formation of Sub-Sections, as outlined in Manual ML-10—Appendix II, be modified such that political boundaries (county lines) are not necessarily the defining factors in the formation of a new Sub-Section. It is also proposed that any such departure from the established county line boundary system be undertaken only after recommendation of the Regional Vice-President with special permission from the Council for each case involved.

Delegates' Action: APPROVED 14 to 0

Council Action: Does not require Council action. Exceptions have been made in the past on recommendation of the Vice-President and with the approval of the Council. The Policy on Formation and Operation of Sub-Sections and Groups (P-18) will be modified to include the above proposal.

Agenda Topic No. 30: Sections to receive vote tabulation of all RAC meetings: It is proposed that all Sections receive a tabulation of the vote on agenda items from all RAC meetings rather than just their own RAC meeting.

Delegates' Action: APPROVED 15 to 0

Council Action: Does not require Council action. The Secretary's Office will send the vote tabulation of all RAC meetings to all Sections.

Agenda Topic No. 33: Regional Nominating Committee be formed to promote Regional interest in selection of Society Officers: It is proposed that a Regional Nominating Committee be established in each Region for the purpose of promoting Regional interest in the selection by the National Nominating Committee of the Society's Officers. The proposed Regional Nominating Committee should consist of one member appointed by the Executive Committee in each Section of the Region to serve for a one-year term. A member of the proposed committee should be appointed chairman by the Regional Vice-President. The Regional Representative or Alternate to the National Nominating Committee need not be a member of the Regional Nominating Committee.

Delegates' Action: APPROVED 12 to 1

Council Action: The Council approved the Vice-President's recommendation that the Regional Advisory Committees on Nominations of Candidates for National Offices may be established at the discretion of the Regional Representative on the national Nominating Committee.

Agenda Topic No. 44: ASME encourage employers to sponsor members' attendance at National Meetings. It is proposed that ASME actively encourage employers to sponsor attendance at ASME National meetings of more engineers who are engaged in the technological and design aspects of engineering.

Delegates' Action: APPROVED 11 to 4

Council Action: Does not require Council action. The Meetings Committee is sending programs of national meetings and Division Conferences to executives of companies in the area of each meeting with a letter inviting them to send their engineers.

Agenda Topic No. 54A: ASME continue to work with EJC to raise professional standards: It is proposed that the ASME continue to work with EJC as covered by their report to raise the professional standards and improve employment conditions of the engineers.

Delegates' Action: APPROVED 10 to 0

Council Action: The Council looks to the membership in the Sections and Student Sections to carry out the recommendation contained in the EJC report "Raising Professional Standards and Improving Employment Conditions for Engineers" issued in May 1956.

Agenda Topic No. 47: Adopt policy opposing registration of corporations to practice engineering: It is proposed that the Council of ASME adopt a policy to oppose the registration or licensing of corporations to practice professional engineering.

Excerpt from RDC Report to Council by W. E. Belcher, Jr., Speaker, 1957 R.D.C.—

The RDC felt that the practice of engineering must be limited to individuals *only* comparable to any other profession. These individuals may work, however, for corporations or in a partnership.

Engineering services may be offered by corporations; however, registered engineers must be in the employ of the corporation and practice the engineering which makes the service possible.

Delegates' Action: APPROVED 12 to 2

Council Action: Council notes this action and feels the position stated in the above is covered by Item 4 of our present policy (P-27), "Professional Engineers Registration Policy."

Agenda Topic No. 55: ASME at Section level encourage promising high school students to become engineers: It is proposed that ASME exert every effort, particularly through the Section, to influence promising high school students to prepare for an engineering or scientific education, in order to alleviate the current shortage of graduates in these fields.

Delegates' Action: APPROVED 12 to 2

Council Action: Council urges continued effort by the Sections to provide guidance to high school students utilizing the ECPD "Guidance Manual for Engineers Aiding Young Men Interested in the Engineering Profession."

ITEMS REJECTED:

To complete the record, the following items that appeared on the original agenda for the Regional Administrative Committee meetings were rejected: No. 1—10.14.2, No. 2—10.18.2, No. 12—10.0.70, No. 22A—12.58.5, No. 32—14.18, No. 36—14.26.3, No. 46—19.16, No. 52A—22.18, No. 53—22.19, No. 54—22.33, No. 56—22.51.

ASME Procedure in Preparing and Discussing Agenda Items

The American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If 25 per cent of the Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring.

Further discussion at a national level takes place at the Regional Delegates Conference held during the Semi-Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Semi-Annual Meeting is to consolidate the actions of the eight RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the actions of the Conference is made to Council during the Semi-Annual Meeting. The Council after studying the recommendations of the RDC refers to the various administrative agencies of the Society the different items with which those agencies are concerned.

After considering comments received from the administrative agencies, the Council acts on the recommendations of the RDC. These actions were reported to the Delegates and Section Executive Committees on Oct. 4, 1957. Thus the cycle from origination of items by the Sections to a reporting of actions by Council is completed within one year.

Compilation of the National Agenda

About September 1 of each year the chairman of the Agenda Committee sends forms to the Sections and requests the submission of items by October 31.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly, as administrative matters, to the proper administrative agency.

On December 21, a compilation of all items accepted by the Agenda Committee is sent to the Sections for an expression of opinion as to inclusion in the final agenda. By the end of February, the Agenda chairman must have all the opinions. Twenty-five per cent of the Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least four weeks in advance of the first RAC meeting.

Action in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points:

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section meeting.

B The expression of opinion about including an item in the National Agenda.

C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with the entire process of developing the National Agenda.

Copies of this report are available by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Actions of ASME Executive Committee

At a Meeting at Headquarters, Nov. 1, 1957

A MEETING of the Executive Committee of The American Society of Mechanical Engineers was held in the rooms of the Society in New York, N. Y., on Nov. 1, 1957. There were present: William F. Ryan, chairman; F. L. Bradley, C. E. Crede, and A. C. Pasini of the Executive Committee; H. C. R. Carlson, R. B. Lea, and Joseph Pope, directors; E. J. Kates, assistant treasurer; E. G. Bailey and J. W. Barker, past-presidents; W. H. Byrne, vice-president; G. M. Muschamp, Organization Committee; W. F. Thompson, ASME representative, UET; C. E. Davies, secretary; O. B. Schier, 2nd, deputy secretary; D. C. A. Bosworth, T. A. Marshall, Jr., and S. A. Tucker, assistant secretaries; and Ernest Hartford, consultant.

The following actions are of general interest:

Deaths. The Committee noted with deep sorrow the death, at Skytop, Pa., on October 21, of Joseph L. Kopf, treasurer of the Society; and, in Italy, of Mrs. Warren H. McBryde, wife of Past-President Warren H. McBryde.

Custodian Funds. Establishment of a Custodian Fund for the Railroad Division has been accepted by the Finance Committee. Although the establishment of a Custodian Fund must have the approval of the Council, it was agreed that future Custodian Funds approved by the Executive Committee will be reported for the record to the Finance Committee.

Unity of the Profession. On Oct. 4, 1957, the Executive Committee voted to refer the AIEE proposal to the Organization Committee for a report on the position of ASME in respect to the unification of the engineering profession as outlined by AIEE. The Organization Committee discussed a report at their meeting of October 31, and recommended endorsing the AIEE plan in principle. The Executive Committee discussed the report and action of the Organization Committee, and requested the Secretary to place an item on unification of the profession on the order of business of the Nov. 30, 1957, meeting of the Council, including the Organization Committee report, the AIEE plan, and a copy of Dr. J. W. Barker's address to ASCE, "Unity, or EJC and the Engineering Profession."

The Executive Committee then voted to receive the report of the Organization Committee and to modify that committee's action to read: "To recommend to the Council that ASME endorse in principle the AIEE plan, as outlined in M. S. Coover's letter to President Ryan, dated March 18, 1957, and reported on page 693 of the July, 1957, MECHANICAL ENGINEERING; to express its willingness to explore the plan with the organizations involved; and to recommend that NSPE join EJC."

Realignment of Regions. Because the plan to increase the number of Regions from eight to ten will involve major changes in the Charter, Constitution and By-Laws, and Society structure, the Organization Committee is of the opinion that further study of it is required. Hence upon recommendation of the Organization Committee, the Executive Committee voted to refer the matter of regional realignment to the Organization Committee for further study in order that comments and actions may be obtained from the Vice-Presidents, Professional Divisions, Technology Executives Conference, various Boards of the Society, and all other interested bodies which might be affected, so that an item on this subject may be placed on the 1958 National Agenda.

Engineering Societies Personnel Service, Inc. (Agency)

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago
8 West 40th St.	84 East Randolph St.
Detroit	**San Francisco**
100 Farnsworth Ave.	57 Post St.

Men Available[1]

Supervisor, Design Engineer, BSME; 35; eight years design, application and test of special custom designed centrifugal and axial flow water pumps. One and a half years design of special custom designed steam surface condensers. Prefers Southeast or East. ME-468.

Development Engineer, MSE, 30; six years in synthetic fiber industry. Chemical and mechanical equipment research, design, development, and testing. Responsible charge of new plant process development and construction. Prefers South. ME-469.

Management, B. Engineer Mechanical; 42; 21 years with large international company engaged in the design, manufacture, and selling of all types of steam generating equipment and auxiliaries. Prefers Northeast U. S. A. or Canada. ME-470.

Chief Engineer, BSME, 35; 15 years handling and direction of engineering and manufacturing problems. Design and manufacturing-engineering experience in air conditioning and related power fields. Prefers metropolitan area but will relocate. ME-471.

General Sales Manager, heavy machinery, conveyers, materials-handling and ordnance equipment. Experienced from shops up through top-level responsibilities. Demonstrated record of accomplishment in technical sales, product development, and administrative ability. Prefers: Northeast U.S., will relocate. ME-472.

Sales Engineer, BSME, 27, four and a half years' diversified electrical apparatus experience with leading electrical manufacturer including engineering, sales, and supervision. Desires smaller manufacturer using both mechanical engineering experience and electrical experience. Prefers Philadelphia. ME-473.

Plant Manager-Engineer, ME, 36; 15 years' experience in plant management, work simplification through mechanization, industrial engineering, factory analysis in soft goods, plastics, machinery manufacturing. Prefers metropolitan N.Y.-N.J. or northern N. J. ME-474.

Mechanical Engineer, design engineer, 27; three years' experience experimental stress analysis, two years instrumentation, teaching experience; interests in process control, gas chromatography. Prefers East Coast or Foreign. ME-475.

Chief Engineer, ME, 40; 15 years design, sales, and construction of special machinery and process equipment. New product and process development. Experienced in application of equipment to automation. Prefers East but will relocate. ME-476.

Sales Manager, BME, 34; nine years' experience in wholesale selling, sales engineering, sales administration and promotion, service management, and research. Excellent combined sales-service executive experience. Traveled widely in mid-western states. Prefers Continental U. S. or selected foreign. ME-477-836-Chicago.

Project Engineer—Instruments, BSME, 33; nine years' experience as project engineer for manufacturer of precision instruments for controlling motion and/or energy flow; can take charge of design or development. Prefers Los Angeles. ME-478-591-San Francisco.

Mechanical Engineer, BME, 35; 14 years' experience with project responsibilities on internal-combustion engines, industrial machinery, navigational instruments. Prefers position with progressive company having essentially non-

[1] All men listed hold some form of ASME membership.

Board on Education. The Secretary reported that reorganization of the ASME Board on Education and Professional Status had been given considerable study by the Organization Committee. The Executive Committee authorized creation of a Board on Education under the Council, and approved establishment of a Committee on Professional Practice.

Meetings and Conferences. The following schedule of meetings and conferences was noted:

Gas Turbine Power Conference, March 2–6, 1958, Washington, D. C.

Railroad Conference, April 9–10, 1958, Cleveland, Ohio.

Production Engineering Conference, April 10, 1958, Worcester, Mass.

Maintenance and Plant Engineering Conference, April 14–15, 1958, Pittsburgh, Pa.

ASME-AIEE Joint National Power Conference, Sept. 28–Oct. 1, 1958, Boston, Mass.

ASME-AIME Joint Solid Fuels Conference, Oct. 9–10, 1958, Old Point Comfort, Va.

Translation of Russian Publications. The National Science Foundation has asked ASME to submit a proposal on undertaking the translation of the Russian Journal of Mathematics and Applied Mechanics. The Executive Committee authorized the Secretary to submit such a proposal and to request a grant from the National Science Foundation to subsidize the project. The Committee also urged Engineers Joint Council to take immediate steps to encourage and insure that a comprehensive program be undertaken for the translation and distribution of Russian scientific and engineering literature in the United States.

Translation of Book on Water Hammer. The Secretary was authorized to sign a contract for the publication of a translation from the French of a book, "Water Hammer in Hydraulics and Wave Surges in Electricity," by Louis Bergeron, the translation rights to which have been negotiated with the French publisher.

Research Agreement. Approval was voted of an agreement for the Division of Engineering Research of Oklahoma State University to conduct an investigation into the validity of the several theories of Bourdon tube performance relative to observed performance under the ASME Research Committee on Mechanical Pressure Elements.

Certificates of Award. Certificates of Award were voted to Eugene W. O'Brien, retiring member of the Board on Honors, and Frank M. Gunby, chairman, Medals Committee. Also to F. Everett Reed, advisory member, National Junior Committee. Also to the retiring chairmen of Sections, as follows: John Mazaika, Long Island Subsection; William B. Legier, Mid-Hudson; Charles W. Weiscopf, Mid-Jersey; John E. Gajarsky, Northern New Jersey Subsection; George Smith, Ontario; Kenneth W. Wilson, Sabine; J. M. Rochm, St. Joseph Valley; and Andrew W. Jenike, Utah.

United Engineering Center. W. F. Thompson reported that some 20 engineering societies have definitely expressed interest in occupying offices in the new Engineering Center. A three-dimensional model of the new building is being constructed.

Member-Giving Campaign. It was reported that C. F. Kettering has accepted the post of Honorary Chairman of the Member-Giving Campaign. An organization for this campaign is being formed. Serving as vice-chairmen under Mr. Kettering will be: E. R. Needles (ASCE), A. B. Kinzel (AIME), and W. F. Ryan (ASME). Vice-chairmen representing AIEE and AIChE have not been announced.

Gantt Medalists. The Gantt Medal Board of Award has announced the 1957 Award to Harold F. Smiddy of New York, and the 1958 Award to Richard Redwood Deupree of Cincinnati, Ohio.

military products. Prefers metropolitan N. Y. ME-479.

Senior Research Engineer, doctor of the technical sciences (PhD) and Diplom Ingenieur of the Institute of Technology, Vienna, Austria, U. S. Citizen, 12 years' experience in advanced math. analysis, internal aerodynamics, thermodynamics, stress and vibrations, gas turbines, clearance secret, 20 technical publications in the U. S. and Germany, experienced scientific writer, speaks English, German, French, and Italian, looking for position as executive in charge of engineering research or representation of American firm in Western Europe. ME-480.

Fuel Engineer, 44; 20 years' experience; includes oil, gas, W. Va., Ky., and Ohio coal by-product, power-plant operation and construction, four years destroyer engineering officer. No preference as to location. ME-481-9426-Detroit.

Sales Engineering Trainee, BME, 25, two years military shop supervision, two years product development, inventory management, and operations research. Interested in packaging and industrial design. Location open. ME-482.

Plant Engineer, Government School in Engineering, 37, plant and maintenance engineer, 14 years' experience; maintenance in general, construction, preventive-maintenance program, administrative duties, safety engineering, powerhouse operation, designing. ME-483.

Executive Engineer, BAeE, MME, Cand. DSciE, industrial and management engineering, 30. Seeks challenging position in consulting engineering, small manufacturing plant, or development organization. Ten years' experience in aircraft-engine development (including reciprocating, turbojet, and rocket) and three years in sales of engineering services (heating, ventilating, and air conditioning). Registered N. Y. and N. J. Prefers metropolitan New York, Northeast, or Europe. ME-484.

Positions Available

Pipe-Erection Engineer, mechanical graduate preferred, to take complete charge. Must be capable of working from prints and making up complete bills of materials on job. To $10,400. Company will pay relocation expenses. Ohio. W-5498.

Senior Designer, experienced in vessel design and piping layout for chemical-processing equipment. Board work. $7000–$8000. Also need a junior draftsman recently out of school, to be trained. $3900, to start. West Orange, N. J. W-5506.

Senior Mechanical Engineer, Steam, graduate mechanical, 50–65, minimum of 25 years' experience public-utility steam-electric generation plant operation. Full knowledge combustion systems and controls, and over-all economics of central station investment and operation. Must be capable of advising on installation and operation of boilers, turbines, generators, and control. Will review proposed designs, layouts, and specifications of equipment for economy and feasibility; check construction programs, contracts, progress, etc. Salary commensurate with past earnings and experience; transportation expenses and quarters allowance paid. Climate subtropical. Duration approximately nine months with possibility of extension. Far East. F-5511.

Water-Power Engineer, to head group engaged in investigations, economic studies, and designs of hydroelectric, flood-control, and water-supply projects. Experience in earth and concrete structures, tunnels, control works, etc., mandatory. Must be willing to travel as required. Southwest. W-5526.

Management Trainees, 25–28, degree in production management preferred; industrial engineering or business administration with a major in management or economics acceptable. Two years training as a manufacturing line supervisor or foreman on machine-shop operations. $5200–$6300. Mich. W-5527.

Design Engineer, mechanical or electrical engineering graduate, experience for design of motor slip rings, brush riggings, and switchgear devices. $8000. Westchester County, N. Y. W-5529.

Sales Engineer, experience, to sell electromechanical devices and controls to manufacturers and industrial plants. $6000, plus. Resident of Springfield Hartford area preferred. Territory, New England. W-5530.

Assistant Plant Engineer, to supervise plant maintenance and repairs, graduate mechanical, some experience in practical chemical-plant maintenance including the supervision and direction of the various mechanical trades. Salary open. Vicinity of Newark, N. J. W-5533.

Lubrication Engineer, preferably graduate mechanical, 27–45, to provide technical assistance to sales force in selection of lubricants, trouble shooting, lubrication surveys, etc., for industrial machinery and equipment, for major oil company. $7500–$9000. Eastern Pa. W-5535.

Design Engineer, graduate mechanical, experienced in heating, heat transfer, thermodynamics in high-temperature hot fluids for manufacturing of such systems. $10,000 plus. New York, N. Y. W-5537.

Application Engineer, experience in the design of boilers, superheaters, economizers, and air heater to meet specific job requirements and to quote jobs and follow up on actual processing after order is secured. Must be thoroughly familiar with ASME Power Boiler and Pressure Vessel Code. Some knowledge of heat transfer work, gas flow, etc. is desired. Salary open. W-5539.

Staff Engineers, 40–50, mechanical graduates, ten to 15 years' experience in plant layout and design as applied to large chemical and metallurgical plants. $10,000–$12,000. N. Y. State. W-5541.

Director, Engineering Standards graduate mechanical, preferably with advanced degree, 38–45, experience in large organizations in fields of heavy machinery, automotive manufacturing, or similar fields. Must be familiar with ASME standards, and organization and administration of standards and procedures for large industry. $16,000–$18,000. Northeast. W-5500.

Chief Research Engineer, graduate mechanical, high-caliber executive engineer, considerable administrative ability in addition to a good background in mechanical engineering field, for company which designs and produces manufacturing equipment for the metalworking industries.

Equipment includes tube mills, roll-forming mills, for both ferrous and nonferrous metals, slitting lines and allied equipment, welders as applied to the making of piping and tubing, and equipment allied to these main lines. Should have engineering experience that will allow applicant to readily comprehend the problems involved in this type of work. Will plan and execute functions of department at a high level of responsibility. Salary open. Midwest. W-5554.

Teaching and Research. (*a*) Mechanical engineer for fundamental research, a minimum amount of teaching in the field of textiles. (*b*) Physicist for research and teaching in the field of textiles. Excellent opportunities. Men will aid in building a graduate school; many opportunities for the application of sound engineering practices to the development of machines and processes for the textile industry. Salaries and rank open, depending upon applicants. South. W-5555.

Chief Development Engineer, 35–45, mechanical graduate, considerable experience in the design and development of high speed automatic machinery as used in paper-converting business. Paper experience desirable but not a prerequisite. Some control-systems experience desirable. $14,000 plus bonus. Mich. W-5558.

Plant Engineer, mechanical or electrical graduate, for top-staff position in leading multiplant operation in durable steel-products field. Must be experienced in work involving design of new and modified plant facilities and supervision of erection and installation. Superb program of compensation, benefits, and paid retirement. Apply by letter giving full particulars. Mo. W-5559.

Tool Designer, minimum of five years' experience in this field. Technical-institute background preferred but trade experience in tool and diemaking acceptable. Will lay out and design tools, jigs, and fixtures to be used in the manufacture of heavy sheet-metal products. $6100–$7500. Upstate N. Y. W-5560.

Production Engineer, 25–30, mechanical or industrial-engineering graduate, for company in the compression and injection molded plastics industry for industrial items. Recent graduate will be considered. $6000–7200. Md. W-5562.

Operations and Maintenance Superintendent, from 35, preferably ME degree; experience in large-scale institutional maintenance and operating. Salary open. Mass. W-5563.

Co-ordinator of Distributor Sales, ME degree or equivalent, under 55, to co-ordinate sales of two, three, and four-way solenoid valves through industrial distributors in continental U. S. Must have working knowledge of solenoid valves and application; experience with distributors and with manufacturing. $8000–$10,000. Company will pay placement fee. Northern N. J. W-5566.

Refrigeration Engineer, considerable experience in the design of hermetically sealed compressor systems, to do own layout work, etc. Any experience in absorption or domestic refrigeration helpful. $10,000–$12,000. New York, N. Y. W-5572.

Production Engineer, young, mechanical or industrial-engineering training and manufacturing experience covering automobile hardware, trim, and accessories. $6000–$8000. Orange County, N. Y. W-5573.

Plant Engineer, mechanical graduate, at least five years' building alteration and maintenance experience covering shop installation, equipment and building maintenance, and safety. Must be familiar with all code regulations. $7500–$8000. Queens, N. Y. W-5574.

Professor, to head up department of mechanical engineering; PhD preferred; some industrial experience as well as teaching experience required. Interests should be in machine design, thermodynamics, etc. $8500–$9000 for nine months; 15 per cent additional for six weeks summer teaching. Available September, 1958. Southwest. W-5575.

Design Engineer, mechanical graduate, machinery design and development experience covering mixers, coaters, cutting and packaging, or allied equipment. $8000–$9000. N. J. W-5579.

Development Engineer, mechanical graduate, design and development experience on valves, temperature, and pressure regulators, controls, etc. $7000–$8000. Western Pa. W-5580.

Mechanical Engineer, graduate mechanical, experience in the design and assembly of automatic production machines. Will be required to de-bug present machines for maximum production efficiency, trouble shooting, designing improvements. To $9000. Mass. W-5583.

Piping Designer, industrial experience to supervise design, layout, and installation of specialty piping and accessories for aircraft-engine-test stands. $6500. Conn. W-5589.

Production Engineer, mechanical or electrical graduate, design and production experience in precision machine-shop fields and assembly of electromechanical devices. $7000–$9000. Putnam County, N. Y. W-5590(*b*).

Industrial and Management Engineer, graduate engineer or Ad. degree, to 35; five or more years in industrial engineering and a knowledge of operations research desirable. Duties will include staff-organizational studies, maintenance and incentive programming, plant locations, and long-range planning, and economic and alternate studies. Plant survey. Thirty per cent travel for chemical or processing industry. $7200–$9600. Employer will negotiate the fee. Chicago. C-6508.

Project Engineer, graduate mechanical, to 40, five or more years in design and development of high-speed automatic machinery. Duties, under the direction of chief engineer, will be development and design of high-speed, automatic, paper-converting machinery. Plant layout and installation of equipment for a manufacturer. $8000–$12,000, depending on experience. Employer will pay the placement fee. Chicago. C-6512.

Engineers. (*a*) Project engineer, to handle engineering phase and co-ordination of customer orders requiring heavy machinery and transmission equipment for sawmills. Work requires a good mechanical-engineering background. Salary open. (*b*) Development engineer, to handle development projects primarily involving the design and building of new (heavy) machinery and some complete redesign of existing machinery for the lumber industry. Employer will pay the placement fee. Salary open. Wis. C-6565.

Industrial Engineer, college degree or equivalent, 35–40, preferably engineering or business administration major and with 12 years' good experience in industrial engineering or accounting systems and procedures, production and/or quality control, marketing and market research, industrial relations, organization or corporation finance. Will handle assignments as consultant or manager for established firm. Traveling during week, will be home on weekends. Employer will pay placement fee. $12,000–$15,000. Headquarters, San Francisco, for Western States. S-3192.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after Dec. 24, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Transfers

Alabama

FARMER, RICHARD J., Mobile
THOMAS, FRANK A., JR., Mobile

Arkansas

CLOWERS, GEORGE D., Pine Bluff
NORRIS, JOHN B., Pine Bluff

California

BELL, NORMAN V., Oakland
KARLIN, EDWARD A., San Diego
KARPENKO, VADIM A., Los Angeles
LINDBLAD, WILLIAM J., San Francisco
MASTROLY, FRANK R., JR., Sun Valley
MCKAIN, FREDERICK C., Los Angeles
SZEGO, PETER A., Los Altos
TAMAKI, CARL M., Los Angeles
VAN SICKLEN, F. DOUGLAS, San Francisco

Connecticut

• BLINDER, WILLIAM, Newington
BULLARD, EDWARD P., 3rd., Bridgeport
KEMMLER, EARL L., Newington
O'BRIEN, MORGAN F., Waterbury
RICCARDI, DONALD P., East Hartford

District of Columbia

• TATE, DAVID B., Washington

• Transfer to Member or Affiliate.

Florida

BESOSA, WILLIAM H., Miami
GOODRICH, JOHN J., Pensacola
KENNEDY, WALTER J., Maitland

Georgia

CHAMPION, JOHN C., JR., Atlanta

Illinois

KELLY, FRED J., Park Ridge
LACOSSE, ROBERT K., Blue Island
MAXWELL, CHARLES T., JR., Barrington
• ROESENER, WALTER J., La Grange
SHIMKUS, JOSEPH J., Evergreen Park

Indiana

KURZE, GEORGE P., Kokomo
TALLEY, RICHARD L., Shelbyville

Iowa

MONAHAN, JAMES E., Des Moines
SANDFORT, JOHN F., Ames

Louisiana

CARLISLE, JAMES V., Baton Rouge
EDWARDS, JOSEPH N., New Orleans
GOFF, JACOB B. M., Baton Rouge
LUSCH, ALBERT F., New Orleans
• VONDY, DAVE, New Orleans

Maryland

• BAKER, WILFRED E., Baltimore
KAMPHAUS, DONALD W., Baltimore
MALONEY, PAUL A., Baltimore
NIELSEN, PERR D., Baltimore
SPENCER, ARTHUR C., Baltimore
WILSON, CHARLES R., Baltimore

Massachusetts

•BARGER, J. P., Cambridge
DENHARD, WILLIAM G., Cambridge
• GRUBER, JEROME M., South Hamilton
LEBOWITZ, S. JASON, Methuen
NASH, CLAUDE W., Nahant
OFRIA, ROSS A., Dedham
• PULIAFICO, CARMELO A., Fitchburg
SEPAVICH, VICTOR, Worcester
STEIN, BERNARD, Bedford
• SWINDELLS, DONALD A., Cambridge

Michigan

AL-SAATI, HASHIM A., Detroit
• LADD, CONRAD M., Detroit
WEBB, EDMUND R., Saginaw
YOUNG, DELEVAN P., Jackson

Minnesota

CHUNG, PAUL M., Minneapolis

Missouri

BAKER, MARION L., St. Louis
• LAMASTER, CHESLEY C., Berkeley
• SIMMONS, ROBERT C., Glendale
TEGTMEYER, RENE D., University City
WILLIAMSON, MAURICE M., St. Louis

New Jersey

BOCCHINO, ALFRED S., West Collingswood
GRAF, JOHN W., Newark
LYMAN, DAVID C., Bloomfield
MAYER, WILLIAM F., Newark
PAASHAUS, ROBERT F., Summit
PEARL, IRVING, W. Englewood
PORSCHE, CHARLES F., Glen Rock
RYAN, WILLIAM R., Fair Haven
STASNY, JOHN W., Waldwick
WALKER, EARL W., JR., Carteret
WALTER, HELLMUTH, Upper Montclair

New York

ALLEN, FRANK A., 3RD, New York
ALTSON, RALPH, Douglas Manor, L. I.
BISSHOPP, KENNETH E., Troy
CAPRITTA, ANTHONY, Schenectady
DEFLORIO, EDMOND, New York
• DRUCKER, EUGENE E., Syracuse
FOLLARI, SALVATORE, New York
KOHN, HAROLD B., New York
LEMASTERS, GERALD E., New York
LYLE, CHARLES A., Wellsville
MERGENS, GEORGE W., New York
NEWELL, FLOYD B., Rochester

(*ASME News continued on page 1214*)

COLOR-PORT

water level gage

gives you . . . two-color readings

. . . low maintenance

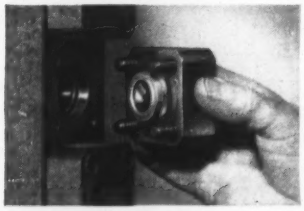
. . . increased availability

You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.



Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

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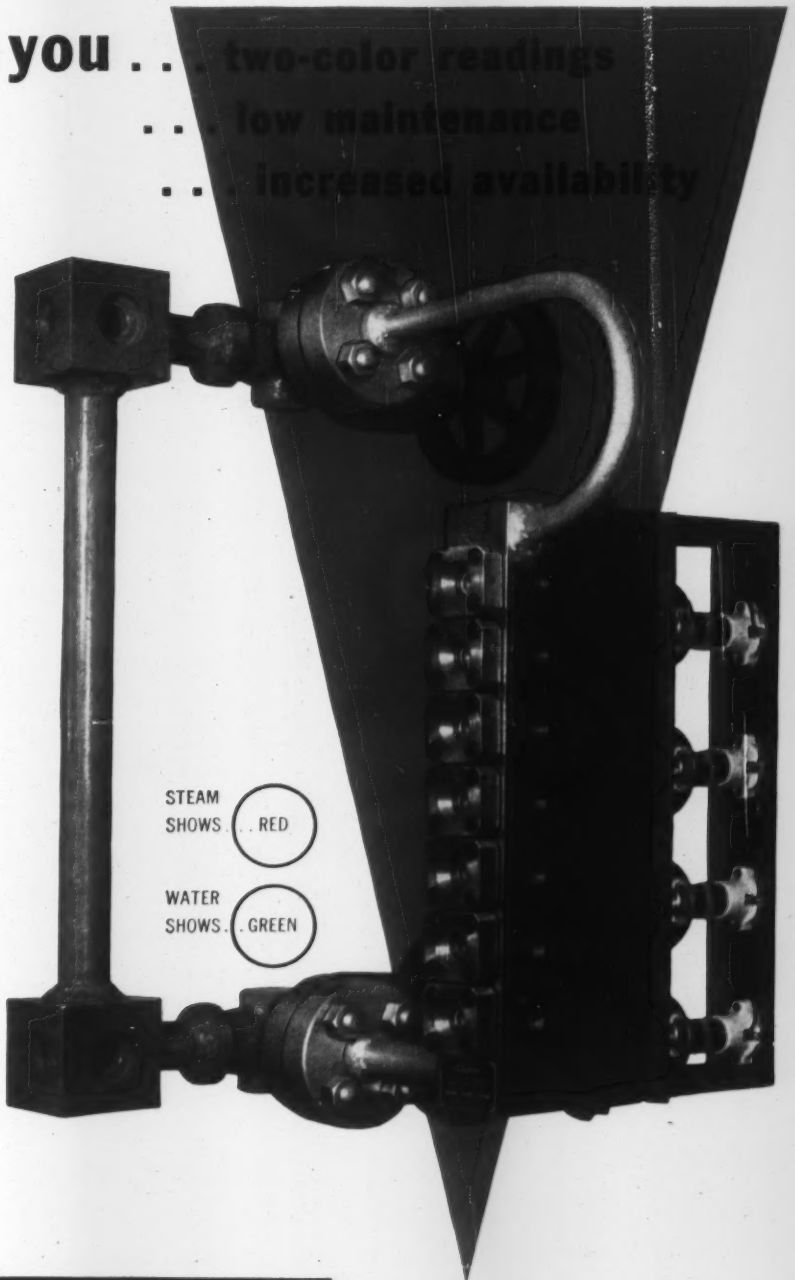

YARWAY COLOR-PORT . . . *a good way to specify high pressure water gages*

PIKULIN, WALTER, New York
RYERSON, OVE K., Brooklyn
SHEPPARD, RAY W., JR., Painted Post
SIMON, RICHARD J., Schenectady
● SLACK, ROBERT E., Johnson City
● STONE, HENRY E., Schenectady
TOPAZIO, WILLIAM J., Levittown
TUMOLO, GERALD M., Yonkers
WALKER, JAMES B., JR., New York
WICKESSER, ARTHUR, JR., Westbury, L. I.
● WOODLAND, N. JOSEPH, Binghamton

North Carolina

FAVOR, SAMUEL T., Charlotte
JONES, DONALD H., Charlotte

Ohio

DERKS, FRED E., Mount Vernon
● DRABEK, STEPHEN, Cincinnati
● EZZARD, HENRY S., Avon Lake
● LANNI, LEONARD, Chillicothe
MCCORMACK, MATTHEW W., Cincinnati
NICHOLAS, LESLIE C., Cincinnati
PROBERT, PAUL B., Barberton
SETTLES, JAMES C., Columbus
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DEMAND, LYMAN D., Pryor
PANKRATZ, HOWARD J., Bartlesville
PYEATT, FREDERICK E., 3RD, Tulsa
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● MILLER, CURTIS D., Portland

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● ALLEN, JOHN L., Upper Darby
CUTLER, ROBERT R., Philadelphia
HUNT, ROBERT O., South Greensburg
KENDIG, ROBERT N., North Wales
KLEPONIS, WALTER J., Lester
KUTCHER, CLIFFORD J., Norwood
MCINNES', A. CRAWFORD Export
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ROBERTS, ALBERT S., Latrobe
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TERRY, JOHN V., Bridgeport
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MALHOIT, EDWARD C., Woonsocket
MARTINI, ROBERT J., Hoxsie
MILETTE, NORMAN J., Manville
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WOOD, ALBERT D., East Providence

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● FOSTER, JACK W., Aiken
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South Dakota

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● CHAPMAN, ROBERT H., Knoxville

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RIORDAN, FRANCIS, Falls Church
STULTZ, CLARENCE J., Falls Church

Washington

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FLEMING, FREDERICK C., Seattle
MARRION, HERBERT J., Seattle
WHITESIDE, ALVIN C., Richland

West Virginia

BUSH, JAMES S., Charleston
HUGHES, DAVID A., Charleston
SHAMBLIN, WILLIAM R., JR., Charleston
WASHBURN, ROBERT L., Vienna

Wisconsin

LINDFORS, JOHN E., Milwaukee
NEVINS, BENJAMIN E., Wauwatosa
PARSKE, CHARLES A., Milwaukee
WILLIAMS, HENRY P., Sturgeon Bay

Foreign

BENN, DOUGLAS H., Ottawa, Ont., Canada
BHARGAVA, RAI B. N., Parbhani, Bombay, India
BLACK, GARY M., The Hague, The Netherlands
● NANDEESWARAIVA, NAMAGONDLU S., West Bengal, India
POLAK, MARIO W., Calgary, Alb., Canada
ROUSSEAU, JEAN, Malton, Ont., Canada
SCHMIDT, ERLING D., Caracas, Venezuela, S. A.
● TUSIEWICZ, JERZY M., Toronto, Ont., Canada

Obituaries

Richard Robert Ashmead (1922–1957?), whose death recently was made known to the Society, had been a group leader, North American Aviation, Inc., Los Angeles, Calif. Born, Philadelphia, Pa., May 18, 1922. Parents, Robert Huckle and Anna Watson (Hale) Ashmead. Education, BS(ME), Drexel Institute of Technology, 1944. Assoc. Mem. ASME, 1944; Mem. ASME, 1955. Mr. Ashmead, whose special interests included gas turbines and rocket propulsion, had published papers concerned with missile technology. He was a registerered engineer in the State of California. During World War II he served in the U. S. Air Force.

George Raymond Avery (1902–1957), superintendent, power department, Columbia Southern Chemical Corporation, Corpus Christi, Texas, died April 12, 1957. Born, Brecksville, Ohio, Sept. 11, 1902. Parents, George and Lizzie Avery. Education, BS(ME), Case School of Applied Science, 1926; ME, 1930; also studied law for one year in night school. Married Marian Lucille Husted, 1930; two children, Ronald Lewis and Janet Carol Avery. Jun. ASME, 1926; Assoc. Mem. ASME, 1933; Mem. ASME, 1935. Mr. Avery had published several papers in technical journals. He was a registered engineer in the State of Texas.

Dana Hamilton Bailey (1904–1957), director, new products and process development, Harris Calorific Co., Cleveland, Ohio, died Aug. 13, 1957. Born, Baldwin, Wis., Feb. 6, 1904. Education, BS, University of Minnesota, 1927. Mem. ASME, 1957. Mr. Bailey held patents for dialysis equipment and an acetylene generator.

Harold N. Brown (1908–1957), production engineer, General Precision Laboratory, Pleasantville, N. Y., died March 22, 1957. Born, Cincinnati, Ohio, May 8, 1908. Education, attended Pratt Institute, 1925. Mem. ASME, 1947. Mr. Brown had been the author of several papers presented before professional societies and published in the technical press.

Frank Atwood Browne (1881–1957), retired consulting engineer, Wayne, Pa., died Aug. 30, 1957. Born, Westboro, Mass., July 1881. Parents, Amandus Frank and Phoebe Ann (Prescott) Browne. Education, Massachusetts Nautical Training School; BS, Massachusetts Institute of Technology, 1906. Married Edna Anna Dever, 1927. Mem. ASME, 1913. Mr. Browne designed the machinery for the locks of the Panama Canal. During World War I, he was general purchasing agent for the Emergency Fleet Corporation which was concerned with constructing and equipping all U. S. Navy craft. In World War II, Mr. Browne came out of retirement to aid again in vital government work. Survived by his widow; his son, Frank A. Browne, Jr., Falls Church, Va.; and his daughter, Mrs. George L. Carson, Wynnewood, Pa.

Donald Campbell (1877–1956), retired member of the firm of Morrison, Kennedy and Campbell, patent and trademark lawyers, New York, N. Y., died Dec. 19, 1956. Born, Newport, R. I., June 17, 1877. Parents, Gen. John and Mary (Price) Campbell. Education, ME, Stevens Institute of Technology, 1897; LLB, New York Law School, 1899. Married Esther Kent, 1924. Mem. ASME, 1914. Survived by his widow; and a son, John Boylston Campbell.

William Crary Dart (1869–1946), whose death in 1946 was made known to the Society recently, had been chairman of the board, Rhode Island Tool Co., Providence, R. I. Born Providence, R. I., April 21, 1869. Parents, William Burdick and Mary (Crary) Dart. Education, BS, Massachusetts Institute of Technology, 1891. Married Grace Thomson George, 1894; one daughter, Margaret Dart Dunbar. Assoc. Mem. ASME, 1907.

Harry de Lapotterie (1880–1957), retired consulting engineer, The Lamson and Sessions Co., Cleveland, Ohio, died Aug. 19, 1957. Born, Mount Vernon, N. Y., Dec. 23, 1880. Parents, Charles and Luisa May de Lapotterie. Education, U. S. Naval Schools, 1899. Married Gertrude Paton, 1912. Mem. ASME, 1918.

Douglas Thomas Hamilton (1885–1956), publicity manager, The Fellows Gear Shaper Co., Springfield, Vt., died Sept. 26, 1956. Born, Pine Hill, Quebec, Canada, June 20, 1885. Parents, Thomas and Elizabeth (Carpenter) Hamilton. Education, mechanical drawing, ICS; mechanical engineering, American Corre pondence School; Alexander Hamilton Institute. Married Alice A. S. Clark, 1910; three sons, Gweneth A., D. Kelvin, and Kenneth A. Hamilton, Assoc. Mem. ASME, 1916; Mem. ASME, 1920. Mr. Hamilton served the Society as chairman of the Committee on Nomenclature. He served the community as director of the Chamber of Commerce of Springfield, Vt. He had been the author of many articles and books on such subjects as high-explosive shell manufacture, cartridge manufacture, automatic screw machines, electric welding, and others. He held patents on gear cutting equipment and jewelry.

Douglas Henderson (1892–1957), president, Fuel Engineering Co., New York, N. Y., died Aug. 22, 1957. Born, Philadelphia, Pa., May 25, 1892. Parents, Andrew and Mary Henderson. Education, Drexel Institute of Technology, 1913; BS(ME), Lehigh University, 1916. Married Marguerite Stanford, 1917; one daughter, Edith Louise Henderson. Mem. ASME, 1931. Mr. Henderson had been the author of a great many articles published in the technical press on the subject of combustion and steam generation. Mr. Henderson had been a member of the Federal Grand Jury Association for Southern District of New York. He was a registered engineer in the State of New York.

Arthur Crawford Jewett (1878–1957), retired, U. S. Office of Education, Washington, D. C., died Granby, Mass., July 27, 1957. Born, Bath, Me., Aug. 26, 1878. Parents, Edwin Hale and Elizabeth (Chapman) Jewett. Education, BS, Massachusetts Institute of Technology, 1901. Married Blanche Lind von Beseler, 1903; two children, Roger Jewett and Helen (Mrs. Robert L. Lepper). Married 2nd, Mary E. Murray, 1955. Mem. ASME, 1909. Mr. Jewett served the Society as a member of the printing industries division, 1928–1935; and as a member of the committee on policies and the budget, 1933–1935. He had been a member of Tau Beta Pi.

Leroy Miller Kincaid (1896–1956), master mechanic, Gaston County Dyeing Machine Co., Gastonia, N. C., died November, 1956. Born, Gaston County, N. C., May 4, 1896. Education, high-school graduate. Affiliate ASME, 1944. Mr. Kincaid held several patents on feeler motions for looms and a self tightening yarn dyeing spindle.

Gordon Lefebvre (1889–1957), general manager, Clark Brothers Co., Olean, N. Y., died June 27, 1957. Born, Richmond, Va., Jan. 27, 1889. Parents, William Clayton and Martha Harvey (Gordon) Lefebvre. Education, Virginia Polytechnic Institute, 1913; U. S. Military Academy, 1910. Married Kathleen Clark, 1913; children, Gordon and Kathleen Clark. Assoc. Mem. ASME, 1919; Mem. ASME, 1951. Mr. Lefebvre had a varied career and had for many years been president and general manager of Cooper-Bessemer Corp., Mount Vernon, Ohio. In 1941, he had been alternate chairman of the Joint Canadian-American War Production Committee.

Vladimir Leonidas Maleev (1879–1957), professor emeritus, University of Southern California, Los Angeles, Calif., died Aug. 26, 1957. Born, Tiflis, Russia, Feb. 20, 1879. Parents, Leonida G. and Mary P. Maleev. Education, ME, Imperial Technical College, Moscow, Russia, 1902; Doctor of Applied Mechanics, Imperial Polytechnic Institute, Kiev, Russia, 1912. Naturalized U. S. citizen, Los Angeles, Calif., 1925. Married Natalie B. Belikoff, 1912; children, Margaret (Mrs. W. C. Edmister) and V. Leonidas (deceased) Maleev. Mem. ASME, 1921; Fellow ASME, 1947. A prolific writer, from 1902–1919, he contributed at least 30 papers and articles to Russian scientific journals and three books and two papers for German publication. From the time of his arrival in the United States, in 1920, to 1957, he had written almost 50 papers published in technical journals and magazines in addition to five books: Internal-Combustion Engines; Machine Design; Operation and Maintenance of Diesel Engines; Heat Power Fundamentals; and Engineering Heat Transfer. Dr. Maleev served the Society as vice-president of the Mid-Continent

(*ASME News continued on page 1216*)

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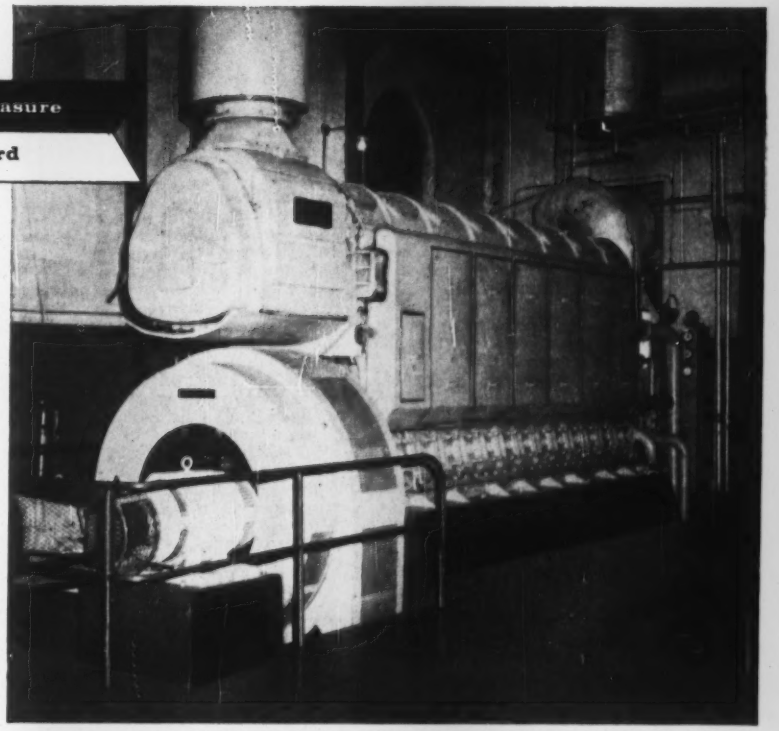

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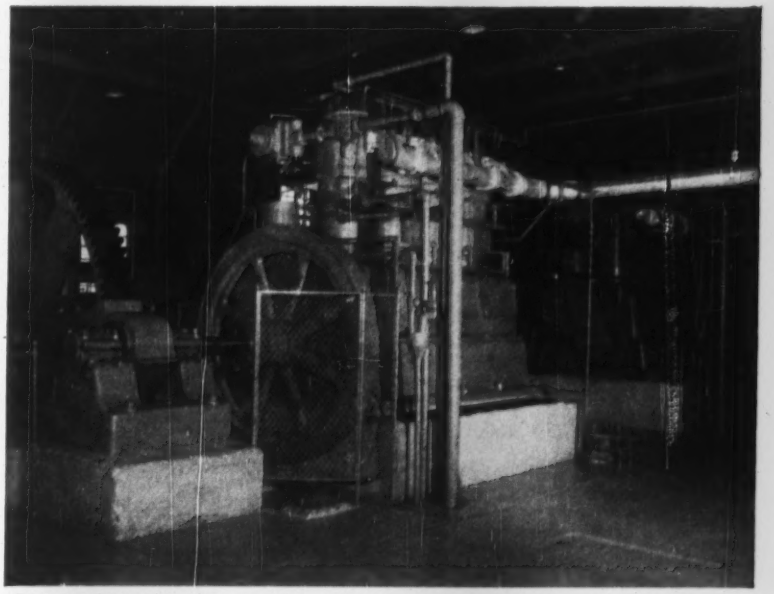

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Section in 1933 and 1934; in 1932 and again in 1944, he served as honorary chairman of the Oklahoma Agricultural and Mechanical College Student Section of ASME. Dr. Maleev began his career as a junior mechanical engineer for the Imperial Russian Government. He began his teaching career as an instructor at the Polytechnic Institute of St. Petersburg. From 1906 to 1917, he was at the Imperial Institute of Technology of Tomsk as professor, department head, and director of the Heat Engineering Laboratory. In 1917, he was appointed dean of engineering and acting president of the Polytechnic Institute of Omsk. His career in the United States was equally distinguished. For ten years he was with Western Machinery Co., Los Angeles, Calif., and was chief engineer when he received the appointment of research professor of mechanical engineering at Oklahoma Agricultural and Mechanical College. The title of research professor of mechanical engineering was granted him in 1941. He successively held significant posts with the United States Naval Engineering Experiment Station, Annapolis, Md.; the Harvey Machine Co., and the University of Southern California, Los Angeles, Calif.; and North American Aviation Co. A licensed professional engineer in the States of Oklahoma and California, Dr. Maleev was also an honorary member of Pi Tau Sigma, and a member of Sigma Xi.

John Roberts Mason (1894–1957), vice-president Millville Manufacturing Co., Millville, N. J., died Sept. 12, 1957. Born, Plymouth, N. H., Dec. 25, 1894. Parents, Harry and Anabella Elizabeth (Roberts) Mason. Education, BS, Dartmouth College, 1915. Married Katherine Keller Gillen, 1920. Mem. ASME, 1941. Mr. Mason had been very active in Dartmouth College Alumni activities. During World War II, he served the Office of Price Administration and the National War Labor Board. Survived by his widow, Mrs. J. R. Mason, Woodstock, Vt.

Robert Everett Newcomb (1884–1947?) whose death was made known to the Society recently, had been consulting engineer, Walsh Holyoke Steam Boiler Works, Holyoke, Mass. Born, Holyoke, Mass., Sept. 11, 1884. Parents, Charles L. and Inez L. Newcomb. Education, ME, Cornell University, 1907. Married Dorothy R. England, 1911. Jun. ASME, 1907; Assoc. Mem. ASME, 1916; Mem. ASME, 1918. Mr. Newcomb was a past president of the New England Foundryman's Association. He served the Society as a member of the management committee in 1928, and as a member of the nominating committee from Group I in 1931. He was a past chairman of the Western Massachusetts Section. He served the community as chairman of the Holyoke Fire Commission. He was the author of several articles which appeared in the technical press.

Reginald Gordon Sloane (1898–1957?), whose death recently was reported to the Society, had been a technologist, public relations, Standard Oil Co. of New Jersey, New York, N. Y. Born, Sands Point, Long Island, N. Y., June 7, 1898. Parents, Charles William and Nina (Byron) Sloane. Education, BA, Harvard College, 1919; chemical engineering, Columbia University, 1923. Assoc-Mem. ASME, 1930; Mem. ASME, 1935. Mr. Sloane received the Wendel Memorial Medal awarded by Columbia University. He held patents concerned with petroleum and petroleum products. He had been a member of the Society of Rheology; ACS; and AAAS.

Gerard Edwin Unger (1902–1957), professor of thermodynamics and heat engines, Universidad de Ingenieria, Lima, Peru, died June 9, 1957. Born, Bielsko, Poland, Nov. 20, 1902. Education, ME, Polytechnic Institute of Lwów, Poland, 1926. Mr. Unger had been a specialist in power engineering and centrifugal pumps, and had been the author of many papers and a series of articles concerning the problem of electrification in Peru. Survived by his widow Dorotea de Unger, Miraflores, Lima, Peru.

Frederic Nelson Whitley (1880–1957), president and treasurer, Frederic N. Whitley, Inc., Brooklyn, N.Y., died April 26, 1957. Born, Brooklyn, N. Y., June 15, 1880. Education, Pratt Institute; New York Trade School; CE, Pennsylvania Military College, 1901. Mr. Whitley had been a heating and ventilating specialist and acted as a consultant and contractor. Survived by his widow, Willie Etta Whitley.

William Horace Williams (1882–1957), chairman of the board, W. Horace Williams Co., Inc., New Orleans, La., died Feb. 6, 1957. Born, Ft McIntosh, Laredo, Texas, June 18, 1882. Parents, William and Eugenie Lelia (Simon) Williams. Education, Denison University. Married Ruby Ionia Mugnier, 1908 (deceased). Married 2nd, Viola Bloch, 1923; children, Elizabeth Ionia Robert Howard (deceased), William Horace, Eugenie Lorrance, John Wesley, and Robert Milton. Mem. ASME, 1950. Mr. Williams had been a specialist in design and construction of heavy engineering structures. He had been a registered engineer in the States of Louisiana and Texas. Survived by his widow.

Lyndon Francis Wilson (1883–1956), president, Wilson Engineering Corp., Chicago, Ill., died Sept. 13, 1956. Born, Rush Lake, Wis., Nov. 4, 1883. Parents, Albert and Grace (Woodhead) Wilson. Education, Lawrence University, University of Wisconsin. Married Anne Togstad, 1906, one son, Douglas W. Wilson. Mem. ASME, 1941. Mr. Wilson had been the designer of five types of boiler blow-off cocks now in general use. He held 18 patents. He had been the author of several articles on treating locomotive boiler feedwaters, and had written several instruction books on the same subject.

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The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

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It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

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☐ Transactions of the ASME	20th of preceding month
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☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
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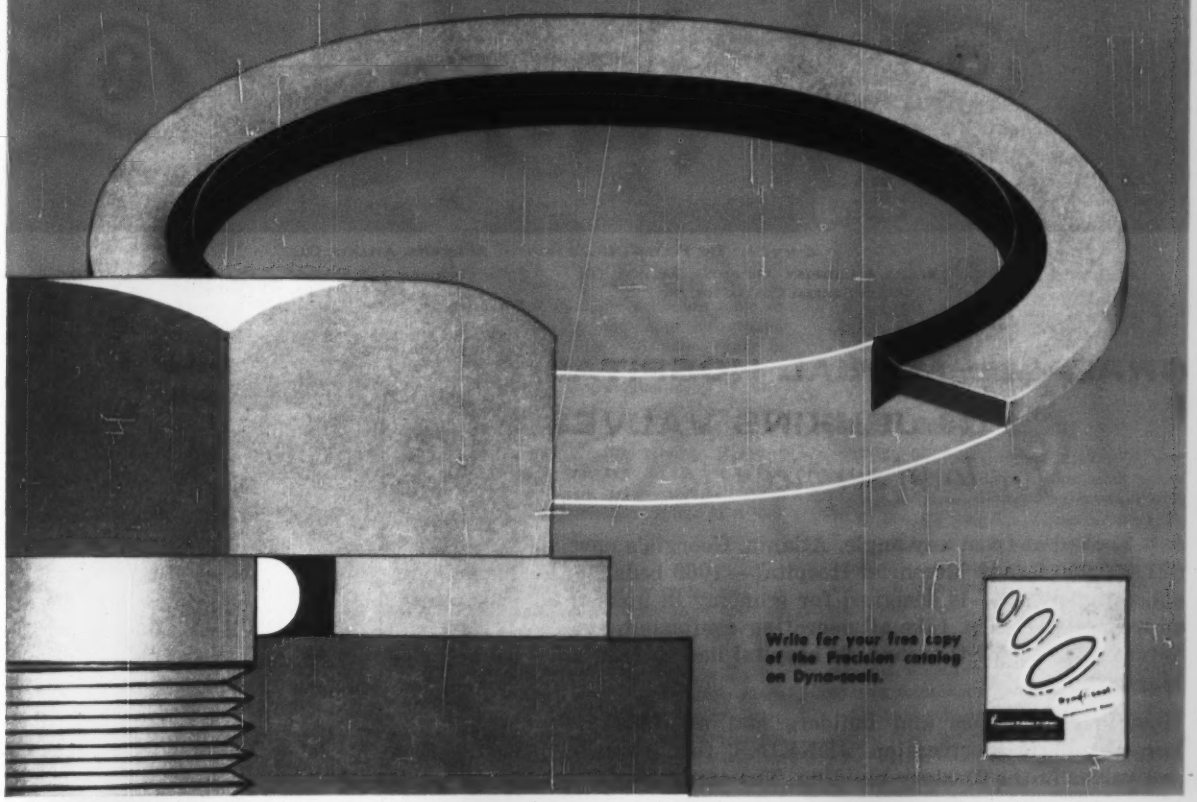

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Looked at from any angle, Atlanta, Georgia's new $21,000,000 Grady Memorial Hospital—1069 beds, 17 operating rooms—is designed for economy in upkeep as well as efficiency. Like all operating equipment, the valves selected for this modern hospital had to pass a tough "physical".

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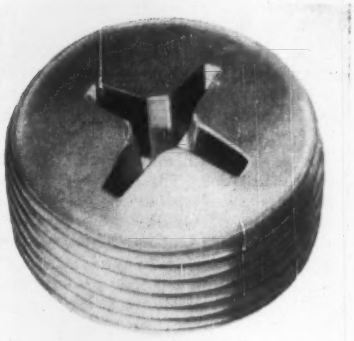


Headless Pipe Plugs

Pipe Plugs, Inc., Wellington, Ohio, announces a new line of slip-proof cross slotted headless pipe plugs.

The units are cold rolled, cold formed and dryseal threaded to eliminate leakers, the company reports. They are designed to replace all other styles of pipe plugs.

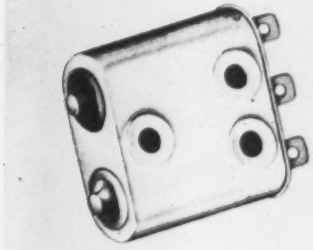
The new plugs are available in steel, aluminum, brass, stainless steel and everdur in the following sizes: 1/16-27, 1/8-27, 1/4-18, 1/2-14, 3/4-14, 1-11 1/2. The plugs may be ordered in breather vents with a porous bronze insert or with a permanent alnico magnet attached.

Whiteprinter

Charles Bruning Company, Inc., 4700 W. Montrose Ave., Chicago 41, Ill. announces development of Copyflex 575, a new, high speed whiteprinter with an extremely wide printing latitude.

The machine is equipped with a 5000 to 7500 w selective switch controlled lamp, an adjustable lamp shield, a machine speed of 75 ft per min, and a 46 in. printing width. This unit is claimed to increase average print production as much as 250 per cent.

The printing width provides side-by-side feeding of small and medium sized tracings, which after exposure, are automatically stacked in the tracing stacking tray. The prints are automatically stacked in one of the front or rear print-delivery trays at the operator's discretion.



Hermetically Sealed Switch

Haydon Switch, Inc., Waterbury, Conn., announces miniature precision switches that are hermetically sealed, yet actuation is not affected by high ambient pressures.

The firm says extensive laboratory tests show that the actuation force remains constant even under atmospheric pressures as high as 180 psi. The switches operate equally well in a vacuum.

A balancing system automatically equalizes environmental pressures on the actuating mechanism, so that the actuation force remains the same, regardless of surrounding pressure or vacuum. Switches can be furnished with an actuation force of either 10 oz maximum, or 32 oz maximum.

The new design can be applied to miniature and subminiature switches of various electrical ratings, the firm reports. Haydon can also furnish this type of switch with a seal impervious to the deteriorating effects of immersion in corrosive liquids like JP-4 fuel.

Centrifugal Fans

A new series of all purpose centrifugal fans with airfoil blading has been announced by the Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

The complete line, Series 8000, will bring airfoil centrifugal fans in an effective range of applications including building ventilation, general air supply and exhaust, conventional and high-pressure air conditioning, industrial processing, tunnel and combustion air supply, the firm states.

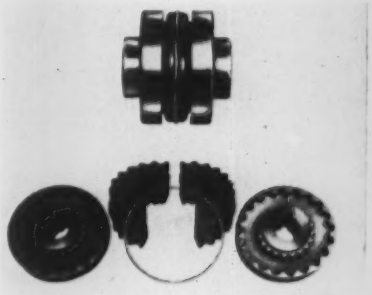
Most fan noise is caused by turbulent flow of air set up by conventional flat blades, the company says, and airfoil blading on the new fan line creates streamlined air flow pattern that makes possible perceptibly quieter operation. Power requirements are also said to be lower with the airfoil blade design.

The new series of centrifugal fans are available in standard AMCA (NAFM) sizes and will handle up to 700,000 cfm at pressures to 16 3/4 in.

Light-Weight Meter

A light-weight, single-joint aluminum gas meter designed primarily for commercial and industrial services requiring large capacity at low working pressure has been introduced by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Designated 750, the new meter weighs 47 lb. Its 15-psi working pressure and capacity of 750 cu ft per hour at 1/2-in. differential and 1600 cu ft at 2-in. differential is said to make it ideal for restaurant, hotel and other commercial and small industrial installations. The unit is available with either 45 light steel spud connection or 1 1/2-in. pipe tap connection.



Flexible Cushion Coupling

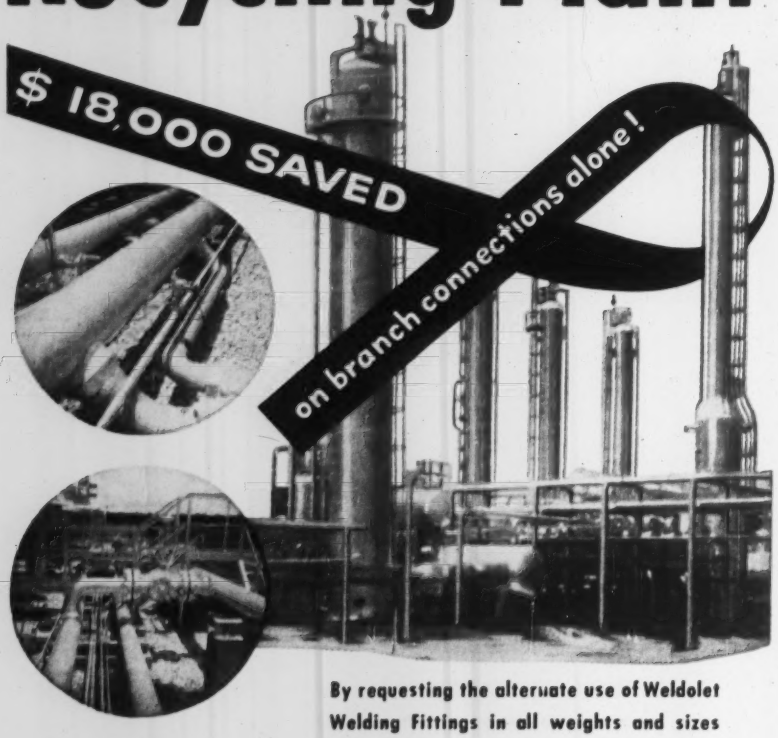
A new flexible coupling with only three basic parts—two hub flanges and a two-piece rubber sleeve—has been announced by T. B. Wood's Sons Co., Chambersburg, Pa.

The internal and external teeth of the flexible sleeve mate with the flange hub teeth and lock tight under torque load without clamps or screws. The elastic rubber sleeve with two planes of engagement absorbs both angular and parallel misalignment, the firm explains, adding that there are no rubbing or wearing surfaces and no need for lubrication.

All shock vibrations are absorbed and prevented from being transmitted by the coupling sleeve. This high torsional flexibility of approximately 15 deg at peak torque provides smooth power transmission, it is reported.

The couplings are designed to tolerate, without wear, internal abuse or high resisting forces, angular misalignment of up to one degree, parallel misalignment of from 1/32 to 1/16 in., depending on shaft size, and free end-float up to 1/4 in., depending on size. Angular or parallel misalignment does not generate unbalance or pulsations since all flexing takes place within the rubber sleeve member.

4500 psi Recycling Plant



By requesting the alternate use of Weldolet Welding Fittings in all weights and sizes the piping contractor was able to lower his bid sufficiently to be awarded the job!

This recently completed recycling plant in Louisiana was designed and engineered in full accordance with the ASA and ASME Codes and operates at a maximum pressure of 4500 psi and 225°.

The piping engineers on this job were confronted with a number of tough problems. The plant was to be operated at extremely high pressures. The terrain was swampy which meant the fittings had to withstand the additional stresses exerted by a settling foundation. The piping also had to stand up under rugged vibration conditions. The many design features of Weldolet Welding Fittings in both full size and reducing size outlets provided the safe, practical and most economical answer to these knotty service problems.

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Spherical Bearings

A standard series of spherical bearings for use in aircraft and industry is now being marketed by Spherco, Sealmaster Bearing Div., Stephens-Adamson Mfg. Co., Ridgeway Ave., Aurora, Ill.

The units are available in five series: SBG, SBG-S, SBG-SA, SBG-LS and SBG-SS. The series covers radial static load ratings from 2700 to 104,000 lb. Materials of construction include for outer race bearings aluminum bronze, cadmium plated; heat treated alloy steel, cadmium plated; carbon steel, cadmium plated; and heat treated stainless steel.

Ball Bearings are available in steel, AMS Spec. 7440. Hardened and hard chrome plated balls used throughout series.

Rubber Compounds

Precision Rubber Products Corp., Dept. M, 3110 Oakridge Drive, Dayton 7, Ohio, announces the development of two new rubber compounds, one for aircraft hydraulic systems and one for home fuel gas accessories and equipment.

Compound No. 737-70 is designed for service in aircraft hydraulic systems with MIL-O-5606 hydraulic oil over the temperature range of −65 to +275 F. This compound meets all requirements of proposed Specification MIL-P-25732 (ASG). All the sizes on the companion drawing MS28775 (proposed) can be furnished from standard tooling.

A new O-ring compound, No. 760-70, is designed for low pressure home fuel gas accessories and equipment, in valves, flanges, gages, couplings, and seals involved in the manufacture or distribution of this type of bottled pressure gas. It is also used for seals with gasolines where service conditions are not too critical, the company reports.

The new synthetic rubber compound is similar in its physical and chemical makeup and its extraordinary resistance to gases, oils, and gasolines to the firm's recently announced compound No. 119-70. The new material has been approved by Underwriters Labs for service in propane, butane, the usual home fuel gases, gasolines of all types including automobile engine fuels, and for fuel oils including the No. 6 grade.

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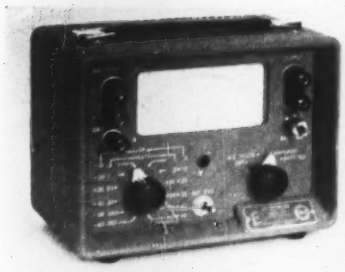

Electronic Voltmeter

A new, portable, multi-range, a-c voltmeter designed to bridge balanced circuits such as encountered in telephone and multi-channel carrier-frequency equipment, is available from the Alectra Div., Consolidated Electrodynamics Corp., 325 N. Altadena Dr., Pasadena, Calif.

Called the Model 15A a-c electronic voltmeter, it is capable of measuring a-c voltages from 1 mv to 300 v full-scale within the frequency range of 30 cycles to 300 kilocycles.

It is 6 x 8 x 6 in., and weighs 6 lb. The unit has transistor circuitry and compact printed wiring. Self-contained battery power-supply, four 4-v mercury cells, is designed to eliminate the disturbances caused by power-line fluctuations.

Although primarily intended for the test and maintenance of telecommunications equipment having 600-ohm balanced circuits, the circuit technique used in the model enables the instrument to be used with unbalanced circuits as well, the firm says.

Power Cylinders

A new line of squarehead hydraulic power cylinders, the first to be offered by the company, has been announced by Anker-Holth Div., Wellman Engineering Co., 2723 Connor St., Port Huron, Mich.

The cylinders are made for service at 2000 psi, or 3000 psi in nonshock installations. All cylinders are tested at 4500 psi before delivery. They are made to JIC standards.

The line comes in bores from $1^1/_2$ through 12 in. and is available in all mountings, standardized for interchangeability.

The cylinders are double acting and can be furnished with precision-adjustment cushions at either end or both ends, without increasing length. Piston rods are of high strength steel, ground, polished, and chrome plated. Steel having 125,000 psi minimum, yield strength is used for the tie rods. Cylinder barrel is cold drawn seamless steel tubing honed to 10 μ-in. finish and heads are machined from cold finished steel bar stock.

The cartridge assembly is replaceable as a complete unit or the bronze rod bushing and rod packing may be replaced separately. V type, spring preloaded rod packing is available in stock sizes and materials to suit all types of fluids.

6000 cps

—a new high in frequency from a high force vibration exciter system

With new 6000 cps rating, the MB Model C10VB electrodynamic exciter further extends the complex motion testing range . . . yet delivers 1750 pounds force for sinusoidal testing with an MB Model T666 15 KVA amplifier (36,000 watt plate dissipation).

This is versatile equipment. With an MB T666 amplifier and TEMC control cabinet, it has the "muscle" to subject electronic products and other critical components to accelerations up to 58 "g". Adding an MB T88 Complex Motion Console equips it for duplicating the actual "noise" or random motion of the environment. This system is designed with an eye to future needs.

What's more, the exciter works in environmental test chambers, so that vibration can be combined with heat, cold, altitude. This not only saves test time, but gives more realistic data on performance as well.

MB C10VB Exciters have UNIMODE rocker suspension (pat. pend.) which assures linear motion and a uniform spring rate over the total stroke of 1-inch (double amplitude).

Users of MB test equipment have at their call a nationwide field service organization of vibration specialists to help on application problems. Send for full data on the complete line MB Shakers.

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STRESS - ANALYSIS

Qualifications: BS, MS, PhD (Engineering). Two to four years' stress analysis background.

Duties: Functions of position to include performing and directing structural and thermal stress, vibration, and impact analyses of advanced nuclear reactor systems.

REACTOR CORE - ANALYSIS

Qualifications: BS, MS in EE, ChE, Physics or Nuclear Engineering (special nuclear training desirable). 1-3 yrs. exp.

Duties: Perform nuclear analysis to determine critical mass, neutron flux distribution, control rod effectiveness, temperature coefficients of reactivity, reactor dynamics, and full cycle reactivity changes.

Write: Answer will be prompt and confidential.

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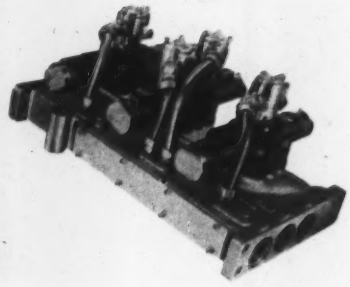

Multiple Manifold

A new high capacity, multiple station manifold, designed to provide compact, economical group mounting of basic 3/4 in. type Speed King 2, 3, and 4-way pilot-operated control valves, is announced by Valvair Corp., 454 Morgan Ave., Akron 11, Ohio.

The company says a cost-reducing filtering and lubricating air supply system can be used in connection with the manifold. Appearance of complex piping is said to be improved by equally spaced cylinder connections.

The new cast aluminum manifold, offered in 2 and 3 station types, has full length inlet and exhaust ports, common to all valve stations. A conduit passage for electrical wiring, with a removable cover for easy access to connections, also runs the full length of the manifold. Inlet, exhaust, and wiring passages all are 1 1/4 in. NPT. Dirt and moisture-proof flexible conduit encloses pilot solenoid leads. To facilitate piping, manifolds are machined for both side and bottom cylinder porting. Either 3/4 or 1 in. NPT port size is optional.

By bolting two or more assemblies together, end-to-end, manifolds can be ganged to provide uniform, compact mounting of 4, 5, 6, or more valves. O-rings seal inlet, outlet, and wiring ports between ganged manifolds. Connection to supply and plugging of terminal ends is facilitated by NPT threading of ports. Holes for mounting manifold assemblies are provided. Kits of O-rings and through-bolts, for ganging manifolds, are available, as is an adapter for ganging the new 3/4 in. basic manifold with Valvair's 3/8 in. basic unit.

Said to be adaptable to any type of control valve application, the new manifold permits mounting of any combination of single or double solenoid valves at any desired location on the manifold. The 2, 3, and 4-way valves can be combined as required. The firm's valves with remote operated, speed control and power-centered neutral options also can be used.

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Trimming Presses

A line of trimming presses has been introduced by Clearing Machine Corp., 6499 W. 65th St., Chicago 38, Ill.

The presses, for use in removing flash from die castings, are said to feature wide bed area with low tonnage and convenient bed openings for disposal of scrap. They are available in hydraulically or mechanically operated models.

The firm has standardized bed and slide area from 32 × 18 in. to 36 × 24 in. and 18 × 12 in. to 34 × 20 in., respectively; lengths of stroke from 3 to 12 in.; strokes per minute from 30 to 120; and tonnages beginning at 25 and going to 60 tons. Standard slide adjustments and slide knock-outs are available.

Polyvinyl Chloride Strainer

What is claimed to be the first all-plastic Y-sediment strainer has been introduced by the Walworth Co., 60 E. 42nd St., New York 17.

Made of rigid polyvinyl chloride, the new strainer is designed for service on alkalis, acids, inorganic salt solutions and other corrosive materials.

The strainer is of rigid PVC sheet with $^1/_{32}$-in. holes. Open area of the perforated screen is at least twice the cross sectional area of corresponding Schedule 80 pipe. The screen, which is welded to the strainer cap, is unscrewed for cleaning.

The new strainer has a service rating of 150 psi at 75 F and 75 psi at 150 F. It is available with either threaded, solvent-weld socket-type or flanged ends, and comes in five sizes from $^1/_2$ through 2 in.

Electronic Detective

A unique precision instrument said to be capable of anticipating bearing failures in rotating machinery has been announced by Lycoming Div., Avco Mfg. Corp. It is claimed that there is no instrument of its type on the market.

The temperature acceleration indicator acts as an electronic detective by detecting acceleration of temperature rise in such units as jet engines, steam turbines, electrical generators, gasoline engines, helicopter transmissions and gear boxes and anticipating the development of a condition dangerous to the bearing, the firm states.

The instrument was developed to meet needs of the division's own test programs.

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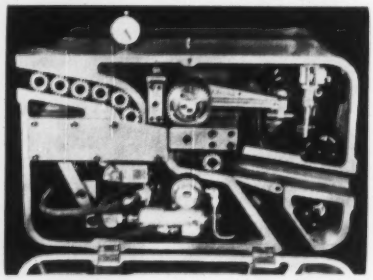

Gear Checker

An automatic gear monitoring unit said to 100 per cent inspect spur or helical gears for concentricity is the latest addition to the gear classifier line developed and built by Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

The new unit uses conjugate rolling action in two directions of rotation with a master gear in mesh with a part to determine and monitor the amount of eccentricity in the part. After checking, parts within predetermined tolerances are automatically passed to the next operation; parts that are eccentric are shunted from the system.

The unit is designed for integration into automated production lines, particularly those lines using the firm's Gear-o-mation systems. One central panel can electrically operate allied automation units.

Total time for the full checking cycle is 6 sec, the company reports, and accuracy adjustment is infinitely sensitive to eccentricity errors.

The unit, initially designed for short planetary gears of automatic transmissions, is available in a range of sizes to suit not only automotive gears but other production applications of larger and smaller gears.

Variable Displacement Pump

A variable displacement piston type hydraulic pump capable of continuous operation at 4000 psi is now in production, according to announcement by Vickers Inc., Detroit 32, Mich.

Contaminant tolerant design is described by the company as an important feature of the new pump; it permits successful operation in hydraulic fluids and engine lubricating oils with particle sizes up to 40μ.

The new pump has axial pistons reciprocating in a revolving cylinder block supported by a trunnion-mounted yoke. Piston stroke, hence delivery, is varied from zero to maximum by changing the angle of the yoke. According to the company, changes made to assure reliability at the higher pressure include redesigned cylinder block, yoke and valve plate, bearings with increased ratings and improved cylinder pin bearings.

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Vibration Fatigue Test

All American Tool & Mfg. Co., 8019 Lawndale Ave., Skokie, Ill., has introduced a new series of vibration fatigue testing machines which provide frequencies from 5 to 100 cycles per second compared to the 10 to 60 cycles of present models.

Cycling can be controlled manually by turning a knob or it can be done automatically through a range selector. This can be set to provide frequencies from 5 up to 100 cps and back to 5, repeatedly, or any segment of frequencies within that range, such as 5 to 11 cps or 70 to 90. It can be held at any one frequency between 5 to 100 cps. Smooth flow of power at any cps is furnished by a motor with integral variable speed drive.

Three new models in the series are in production. Model 10 HA-T has 10 lb table load capacity and Model 25 HA-T has 25 lb table load capacity. Both produce vibration horizontally in simple, harmonic motion. Model 10 VA-T takes 10 lb work load and produces vibration in vertical plane.

All have 50 per cent overload capacity, adjustable displacement, travel or stroke. Work tables are drilled and tapped in symmetrical pattern to provide for bolting down parts or components to undergo test or research.

Single Shaft Gas Turbine

A 3250-hp gas turbine used as a mechanical drive for pumps, compressors or generators has been announced by Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

The simple open-cycle gas turbine operates at 8500 rpm and any output speed can be obtained through the use of gearing, the firm states. It adds that a quick starting feature permits the gas turbine power plant to reach operating speed in less than three minutes.

At full load, the exhaust flow is approximately 191,000 lb per hour at 775 F. This exhaust temperature can be used to produce low-pressure steam with a waste heat boiler or a heat exchanger located in the exhaust duct, it is reported.

The gas turbine is 21 ft long, 6 ft wide and 4½ ft high and weighs 14,000 lb. Mounted on a common bedplate, the unitized structure consists of gas turbine, driven apparatus, starting equipment auxiliaries and controls. Only the external utility connections are required before the plant is ready for operation. The total weight of the plant is 27,600 lb.

According to the company, the unit has automatic protection and semi-automatic starting and stopping controls. The system is so arranged that it can be adapted to remote control. The turbine incorporates the split casing and simplified two-bearing construction.

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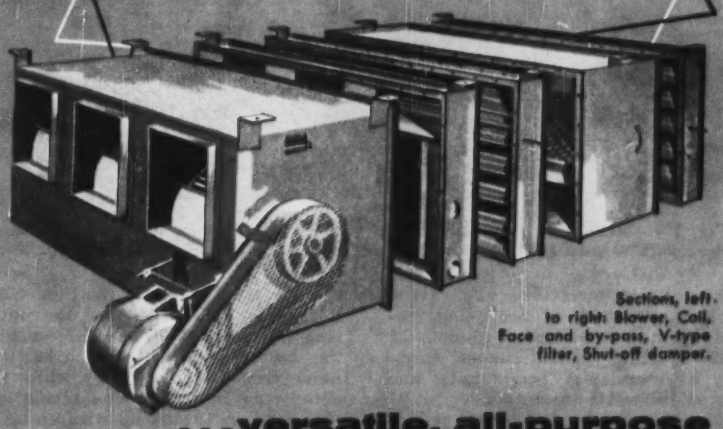

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MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

MEASUREMENT OF RADIAL RUNOUT

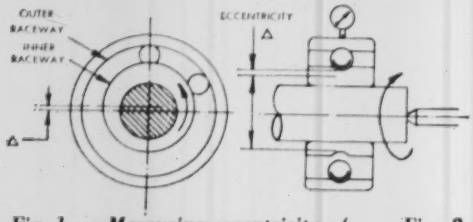

Fig. 1 — *Measuring eccentricity of bore with respect to inner raceway.*

Fig. 2 — *Inner raceway is out-of-round, although concentric with bore.*

Occasionally questions are raised about the methods of measuring "radial runout" and "out-of-round". In order to define "radial runout" properly, a discussion of "eccentricity" and "out-of-round" is necessary.

The amount of out-of-round, or lack of roundness of a given part (inner or outer ring or ball) is the difference between the maximum and the minimum diameter of the part in question.

Eccentricity refers to the distance between the centers of two circles. Concentricity refers to the exact coincidence of the centers of two or more circles. In high grade instrument bearings there is a very small tolerance on the permissible eccentricity between the bore and the inner ring raceway, and likewise between the outside diameter and the outer ring raceway.

Inner raceway out-of-round is measured by forcing the ring between the rounded edges of two discs, one of which is fixed and the other of which is mounted on the indicating mechanism. The difference between the maximum and minimum readings reveals the amount of out-of-round. Out-of-round of the outer ring raceway is measured by placing the ring over two rounded points which engage the raceway. One point is fixed and the other actuates an indicating mechanism. As the ring is rotated, the difference between the maximum and minimum readings indicates the degree of out-of-round.

The true amount of eccentricity between the bore and the inner ring raceway can be measured, providing these circles are not out-of-round, by mounting the assembled bearing on a slightly tapered arbor, applying a calibrated indicator on the center of the stationary outer ring, and then slowly rotating the arbor. The eccentricity is the difference between the minimum and maximum gage reading as the arbor is rotated through one revolution. Similarly, the eccentricity of the outer ring is measured by the difference in the dial readings with the arbor and inner ring held stationary while the outer ring is rotated one revolution. *Fig. 1* shows the set-up with an inner raceway which is eccentric with respect to the bore.

In the case above it has been stipulated that the bore and inner raceway must not be out-of-round, for only under these conditions is the true eccentricity measured.

If the raceway is out-of-round, while being either eccentric or concentric with respect to the bore, the out-of-round will be transmitted to the indicator, thereby influencing the reading. A condition in which the inner raceway is out-of-round although concentric is shown in *Fig. 2*.

In view of the fact that the majority of bearing rings will unavoidably be somewhat out-of-round and eccentric, however slightly, it is obvious that the measurement described above indicates neither true eccentricity nor true out-of-round but a summation of the two quantities. Hence, the measurement is more correctly termed radial runout.

DESIGN HANDBOOK OFFERED *FREE*

If you work with miniature bearings, you'll find this new, 70-page authoritative publication contains a further discussion of radial runout and is a great help in solving problems in designing instruments or small electro-mechanical assemblies.

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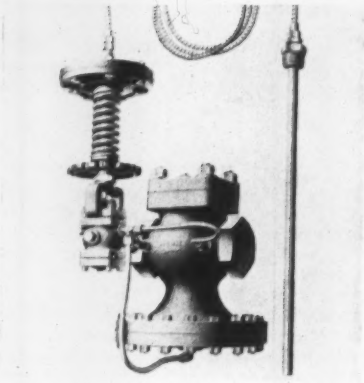

Temperature Regulator

A new temperature regulator offered by Spence Engineering Co., Walden, N. Y., consists of the firm's Type E main valve controlled by a new T14 pilot.

The T14 pilot is recommended by the company for slow-heating units such as storage heaters for oil and water, plating tanks, kilns, and ovens.

When the volume of heated fluid is large compared to the rate of steam supply, a simple, temperature-actuated pilot produces close regulation. The type T14 pilot automatically opens and closes the main valve as required to maintain a constant temperature. The regulator applies line pressure to the heating equipment. If the equipment is rated for less than line pressure, a pressure reducing pilot (type D) to limit steam pressure to be a predetermined maximum can easily be connected to the T14 pilot.

Vibration Exciter

Model CLOVB vibration exciter announced by the MB Mfg. Co., Div., Textron Inc., New Haven, Conn., provides a force output as high as 1750 lb and has a frequency range of 5 to 5000 cps. said to be the highest-frequency electrodynamic vibration exciter in its force range, the unit is reported to be capable of operating continuously at rated force under severe environmental-chamber conditions because of its highly efficient circulating-liquid cooling system. Force levels of 1050 lb rms and 3150 lb peak are obtainable in noise testing with a 15-2000 cps bandwidth, the firm states.

Environmental performance specifications for the new vibration exciter are altitude from 0 to 125,000 ft, humidity from 0 to 95 per cent, temperature from 0 to +200 F without temperature barrier and −100 to +300 F with temperature barrier. Total table displacement is 1 in. (±½ in.) between stops. The cast-magnesium table itself weighs 30 lb and has an 8-in. outer-bolt circle and 13 stainless-steel replaceable attachment points.

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Steam Distributing Coil Line

A new 1-in. OD double-tube steam distributing coil unit having supply and return connections at the same casing end is now available from American Blower Div., American-Standard, Detroit 32, Mich.

The new unit, designated Type D1, is an expansion of the company's line, providing a heating coil of freeze resistant design suitable for use in a broad range of installations.

The coil is available with one or two tube rows deep in a single section for a wide variety of casing sizes. Because two rows in one section are possible with company's design, compactness is claimed to be an outstanding feature of the new coil assembly.

Effective freeze resistance and good temperature distribution depend on complete and rapid removal of condensate from the tube. Use of outer tubes of 1-in. OD and inner tubes of $^{5}/_{8}$-in. provides optimum space between tubes for unrestricted condensate flow. In addition, a patented inner tube spacer design is used for positive centering of the inner tube so that condensate will drain rapidly and completely. Further assurance of efficient drainage and maximum performance is achieved by pitching the tubes toward the header within the casing, the company states.

Casings are of zinc-coated heavy gage steel. Type D1 double-tube heating coils are available with fins of aluminum or solder-bonded copper. Headers are of heavy welded steel plate with high-temperature-brazed inner and outer tubes. Type D1 coils are recommended for steam at 200 psig and 450 F.

Speed Variator Line

A new line of packaged adjustable speed drives has been announced by General Electric's Direct Current Motor and Generator Dept., Schenectady 5, N. Y. The new speed variators are available in ratings of 3 to 150 hp and in speed ranges of 8 to 1 and higher.

They are designed for use on continuous processing lines, calender drives, machine tools, crane hoists, metal rolling and blooming mills, paper processing machinery.

A new Amplistat regulator with silicon rectifiers is standard on the new line. The company says the regulator provides smooth, timed acceleration and deceleration to preset speeds in addition to voltage regulation. New static excitation system with silicon rectifier has no moving parts and requires no warm-up period, it is reported.

The motor-generator set is of two-unit, four-bearing design. Tri-Clad 55 a-c motor and d-c generator are connected by flexible coupling. Standardized power unit control devices are unit-mounted and front-connected The firm says recessed wiring troughs eliminate wiring harness and improve accessibility. Incoming power and control connections are simplified by terminal boards.

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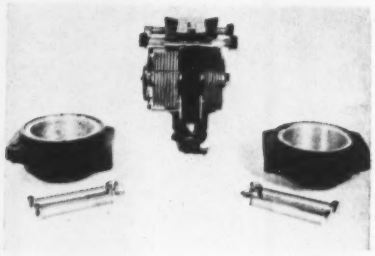

Flow Meter

A bellows-type flow meter accurate to within $\frac{1}{2}$ of 1 per cent and designed primarily for the oil and chemical industries has been developed by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

The differential pressure measuring device, according to the firm maintains this accuracy even when ambient temperature changes by as much as 100 F and static pressure reaches 2500 psi.

In operation, differential pressure is applied to the bellows unit through high and low pressure connections. As the differential pressure changes, the liquid fill in the bellows unit moves from high to the low pressure side, or vice versa, changing the tension of the range spring. This moves the bellows connecting rod, repositioning the torque tube arm. The torque tube shaft is connected to the transmitter unit so that a change in differential pressure changes the transmitter output.

Range of the flow meter is changed in the field by springs available in 15 different ranges between 0–20 and 0–400 in. of water.

Other features of the new flow meter include a linear damping adjustment and an accessible external suppression adjustment for use when the meter body measures liquid level in closed tanks.

Turbine Safety Valve

Crosby Valve and Gage Co., Wrentham, Mass. has announced for its standard reheat header spring loaded safety valve line a feature designed to protect against overspeed of the low pressure turbine in case the intercept valve fails to close on loss of turbine load.

The device consists of an air lift cylinder added to the conventional spring loaded valve for lifting the valve to its full discharge capacity at any pressure down to zero. The air lift cylinder will open the valve to its full capacity in less than a tenth of a second, the company reports.

The air lift mechanism is controlled by an over-speed switch on the turbine that acts immediately when over-speed due to loss of load takes place. By the opening of the reheat safety valves immediately on an increase in turbine speed, the pressure in the header is relieved so that cause of the over-speed is removed.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Over-Riding Cranes

A newly designed line of over-riding cranes has been announced by the Becker Crane and Conveyor Co., 4900 Ridge Rd., Cleveland 9, Ohio.

The new models are available in capacities from 1 to 10 tons and for spans up to 50 ft. Hand-pushed, hand-chain driven or motor-driven styles are supplied. They are available as a completely assembled unit or as packaged components for assembly at the job site.

Individual components include end trucks with necessary bridge beam attachment fittings, motor drive parts, controls and electrification equipment. Drawings for on-the-job crane assembly are provided.

The end trucks consist of welded steel, box type structures, rigidly diaphragmed. Designs for either single or double bridge construction can be furnished. Large diameter, cast iron wheels with hardened treads are mounted on antifriction bearings of either straight, tapered or spherical roller type. Bearings are pressure lubricated and both tapered or crowned tread styles are available.

On hand-chain driven or motor-driven models, machine cut, removable, steel drive gears are supplied. All gears are fully shrouded. Rail sweeps and large maple bumpers are provided as standard equipment.

Tube Heat Exchangers

Expansion of its line of Karbate brand impervious graphite shell and tube heat exchangers has been announced by National Carbon Co., Division of Union Carbide Corp., 30 E. 42nd St., New York 17.

Three new sizes, with 8-, 42-, and 45-in. diam shells, bring to 16 the total of standard heat transfer units available for corrosive service.

Sizes range from 6-in. diam to 45 in., containing from 9 to 685 7/8-in. ID impervious graphite tubes. Standard tube lengths are 6, 9, 12, 14, and 16 ft. A total of 77 separate combinations of tube bundle diameter and tube length covers a range of from 17.7 to 3585 sq ft of heat transfer surface on the outside of the tubes.

Motor Starters

A new line of 2300 to 4160-v starters, Type H, for full or reduced voltage starting, reversing or nonreversing, dynamic braking or multispeed control of squirrel-cage, synchronous or wound rotor motors has been announced by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. The new starter is available with either air brake or oil immersed contactors up to 1500 hp at 2300 v or 3000 hp at 4600 v. Short circuit protection of 150,000 kva at 2300 v and 250,000 kva at 4160 or 4600 v is provided by current limiting fuses.

Diamond

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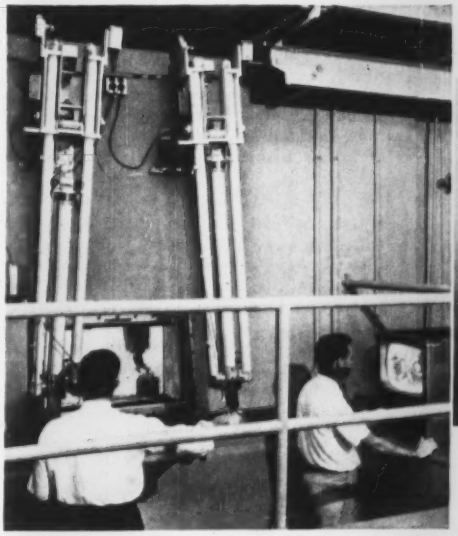
(WIRED TELEVISION)

IMPROVES HANDLING of RADIOACTIVE MATERIAL



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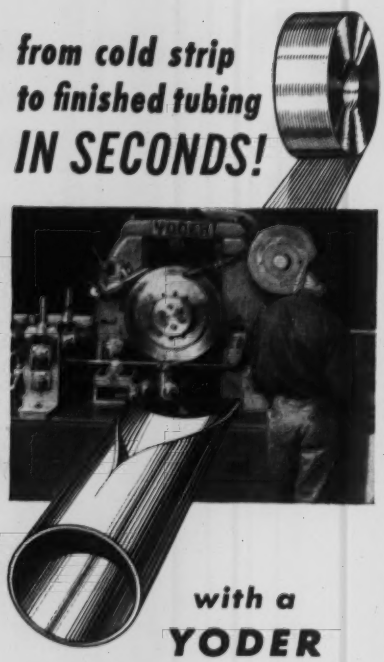

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The Yoder Type-M Mill shown above is operated by one man and a helper. Coiled strip on this mill is continuously cold-roll formed, welded and cut to required lengths in a matter of seconds . . . at speeds up to 340 f.p.m. The quality of the resulting tube is *constantly* better than the requirements of commercial standards. This is one of many reasons why manufacturers and users of tubing the world over are using more Yoder mills than all other makes combined.

If your business requires pipe and tubing, ferrous or non-ferrous, in sizes from ¼-inch up to 26-inch diameter, Yoder can supply the engineering service and machines to produce it faster and better for less! For complete details, write for the Yoder Tube Mill Manual. It's yours for the asking.

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YODER — PIPE AND TUBE MILLS (ferrous or non ferrous)

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

High Service Valves

What is described as a new development in the treatment of valve discs, to promote valves into high service brackets has been announced by Kennedy Valve Mfg. Co., Elmira, N. Y.

According to the firm, its regular quality valves equipped with treated discs and a new packing material have completed more than 15,000 cycles of operation at 18-lb closing torque on 150 lb saturated steam lines without any signs of failure and without repacking.

They are named the Plus 15,000 valves, and the new discs are called Kennedized discs. This treatment is a process that deposits a very hard and tough chromium alloy, with a hardness of 70 Rockwell C, on the disc face. The deposit will not crack, flake, or peel as ordinary chromium can, the firm states. An extremely low coefficient of friction results and the valve seat in service becomes progressively more highly polished instead of galling, it is reported.

Submersible Pump

Five new design improvements are claimed to be incorporated in the cast-bronze construction of a new Kenco Model 110 submersible pump, according to an announcement by Kenco Pump Div., The American Crucible Products Co., 1305 Oberlin Ave., Lorain, Ohio.

The pump's capacity has been increased to 5000 gal per hr at a 10-ft head, with a 30-ft shut-off head. The pump combines the high torque output of its ½ hp motor with a new direct-drive non-clogging pump impeller and uses a new ceramic seal-seat mounted on the impeller back to seal completely the motor shaft away from the fluid being pumped, the firm states.

Completely submersible, the new pump is engineered for service in sump applications in utility tunnels, elevator pits, transformer vaults, removal of factory wastes and air conditioning condensate, dewatering of flooded basements or construction areas, circulating machine tool coolants and cutting oils, and in systems requiring continuous circulation of liquids, the company states.

The firm's exclusive liquid level control switch is built into the watertight top of the new pump. Actuated by rising water which compresses air to flex a nylon-neoprene diaphragm, the switch is said to need no adjustment. It does not have any floats, weights or wires.

The pump is available with any of three controls: non-automatic for installations requiring continuous or separately controlled operation; fully automatic, adjusted for varying operating conditions; manual-automatic for portable applications where manual starting is desired with automatic stopping. According to the company, addition of Hi-Turn-On control permits the pump to turn on from 9 in. to 7 ft in extra deep sumps.

BINDERS

For Your Codes and Standards

These binders are well constructed, open flat; hold the publications firmly; and permit insertion, removal and transposition of contents easily. They are made of durable cloth, have identifying title stamped on the spine, and are 9" x 12" in size.

The Binder for the ASME Boiler and Pressure Vessel Code has a four inch capacity and is equipped with twelve flexible steel rods. That for Standards and Codes has a three inch capacity and holds from twenty to twenty-five pamphlets.

$3.25 each

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Vertical Gearmotors

A new line of gearmotors, vertical type MV series, is now available from Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich.

According to the company, the new gearmotors solve problems found in driving vertical shafts, particularly in many mixing applications, and are suited for wall-mounted applications since the worm is then located below the gear. They are equipped with a mounting base for floor, ceiling or wall mounting, in either standard or hollow shaft models.

The gearmotors are double-reduction units with a helical primary and double-enveloping worm gear secondary. Load-carrying capacities are higher than those obtained from cylindrical worm gearing because of the unique hour glass worm that meshes with a throated gear, the firm states. The two gears, in effect, wrap around each other.

All teeth in both gears are straight-sided and tangent to a common circle, and in contact the full depth of the teeth. The company points out that one-eighth of the gear teeth are always in mesh and the resulting high area contact between worm and gear teeth spreads unit loads over a greater area.

Gearmotor sizes are currently available to handle 1 to 15 hp standard NEMA D-flange motors. They are available in 27 standard output speeds from 7.3 rpm to 525 rpm. Units to handle motors to 50 hp are now in the development stage and will be available soon, the firm reports.

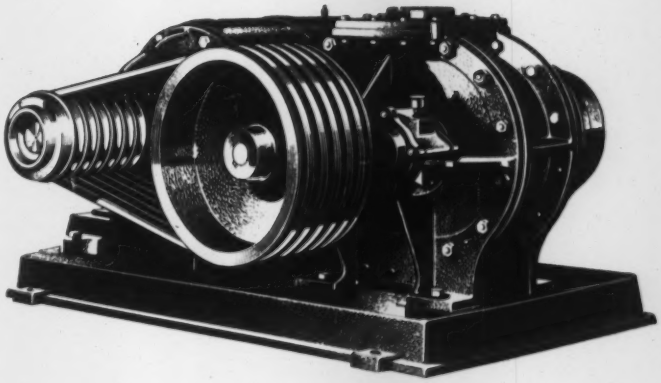
Transmission Belt

Belt stretch is reduced to a minimum in a new transmission belt announced by B. F. Goodrich Industrial Products Co., Akron, Ohio.

Length uniformity in the new belt, designed for use on all type drives, is maintained by controlling the amount of moisture in the air during manufacture, the firm reports. It is overcome by manufacturing the belt in a room under controlled humidity conditions.

The belt is packaged in a hermetically-sealed polyethylene bag to prevent moisture from entering the cords during delivery and storage. The new belt is named Unicord because the tension member consists of one ply of super strength synthetic cord. This single ply, the firm claims has the strength of five plies of our No. 50 cord.

Flex life of the Unicord belt is said to be greater than other constructions on small pulleys because there are no plies to separate. The loop built belt has folded edge construction formed by a black 2-ply straight-laid wear-resisting envelope cover. Pulleys as small as 4-in. are recommended. This belt is available from 4 to 6 in. in width and 100 in. to 45 ft in length.



R-C gas pumps eliminate friction and leakage problems

One of the many operating advantages of Roots-Connersville rotary positive displacement gas pumps are the exceedingly small losses due to leakage and friction. This high efficiency is assured by the inherent design of the pump in which the impellers operate without internal contact. Yet so accurately gauged are the clearances that slippage is reduced to an absolute minimum. Maximum power savings are realized since horsepower required is determined by operating pressure.

From 5 to 50,000 cfm, these pumps assure positive control of both volume and pressure. Design simplicity further assures long term peak performance with little down-time and maintenance held to a minimum.

Available in 76 capacities and sizes, R-C rotary gas pumps can be exactly matched to your requirements. For engineering data, write for Bulletin 32-33-B-13 or Bulletin 31-B-17 on small pumps.

Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

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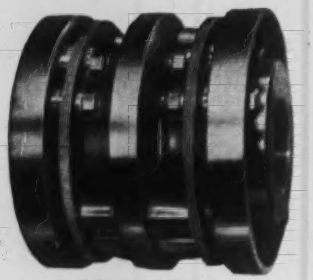
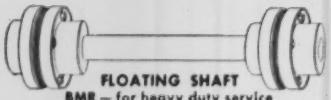


DOUBLE FLEXING
DBZ — for high speed, heavy duty drives



FLOATING SHAFT
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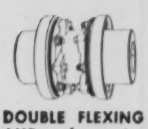

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AMR — for engine and medium speed drives

SINGLE FLEXING
SS — for engine-driven generator sets with out-board bearings

Thomas' 40 years of flexible coupling experience is at your disposal to help you meet ordinary applications or special variations for unusual cases.

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WARREN, PENNSYLVANIA, U. S. A.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Centrifugal Pumps

A new series of single stage, end suction, centrifugal pumps, designated the H series, has been introduced by Nagle Pumps, Inc., 1249 Center Ave., Chicago Heights, Ill.

Three types of water-ends are available to meet specific needs: type HR for handling abrasive mixtures where head is limited; type HC with split bearing stand for purely corrosive application; and type HF for either abrasive or corrosive applications where high pressures are developed.

The water-end or casing can be rotated to any one of four positions, providing discharge of pumped material in any one of four directions, the company reports.

Slippage seal adjustment is said to take only moments using a common wrench. One bolt is loosened and an adjacent bolt is tightened, acting upon an internal leverage mechanism. Adjustment can be made when pump is in operation.

All models in the new series are available in sizes from 1 to 10 in., for heads up to 250 ft or more, and capacities to 4000 gpm.

Breaker-Conveyor

Up to five manual processing and handling operations in chemical plants are said to be combined in a new automatic breaker-conveyor developed by Gifford-Wood Co., Hudson, N. Y.

The unit consists of a chemical breaker and a screw conveyor driven by the same motor as the breaker drum. Materials are crushed and delivered to storage silos in one operation, the firm reports. Designed to handle all semi-friable bulk materials from $\frac{1}{2}$ to 5 in. thickness, the heavy-duty breaker is said to be capable of crushing up to 100 tons of solidified chemicals per hour. The conveyor is timed to the operation of the breaker.

In operation, chemical cake is fed into the breaker through a hopper opening. The cake drops onto a revolving drum strung with lines of steel spikes that pass between teeth of an adjustable steel comb-plate attached to the walls of the breaker.

As the drum turns, particles fall through the openings between the drum and the teeth of the comb, and out the bottom of the breaker. An operator controls particle size by varying the distance of the comb-plate from the drum surface.

The small pieces then move to the screw conveyor, consisting of a half pitch screw enclosed in a tube, both of stainless steel. The material passes through a delivery opening at the top of the conveyor and into a flexible connector.

The breaker body is made of stain-clad steel with welded webs and flanges. All contact parts of the breaker are of alloy steel construction. Motor, which drives both the drum and screw conveyor, is housed at the top of the machine. Stop-start controls are mounted outside of the breaker.

Diaphragm Valves

A full line of diaphragm-operated control valves, with ductile iron bodies for use with high pressure, high temperature hot water, is announced by Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.

Designed for control of rubber molding and similar equipment, the ductile iron valves are said to be suitable for hot water service at pressures up to 600 psi and temperatures as high as 350 F. The ductile iron used in the bodies of these valves is reputed to be much more corrosion-resistant than steel and has a tensile strength approximately three times that of bronze.

Hardened stainless steel stem and replaceable seat inserts is designed to assure long, leak-free service. Skirted seat rings are said to resist wire drawing. Complete interchangeability of parts simplifies field maintenance, and the union nut, which retains lower seat, is removed for quick inspection of valve seats, the manufacturer states.

The valves are offered in 2-way, 3-way normally open or normally closed and reverse acting types. Sizes range from $\frac{1}{2}$ to $1\frac{1}{2}$ in. NPT. Top diaphragm, actuated by 20 to 35 psi air, can be operated by the firm's cycle controller, any applicable pneumatic or electro-pneumatic cycle control device, or manually.

Hollow Shaft Motors

Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis. has published a four-page bulletin, No. 2050, on climatized vertical hollow shaft motors.

These open drip-proof motors, in NEMA frames 364 to 505, are for shallow- and deep-well turbine pump applications. The bulletin stresses such motor features as climatized enclosure that provides all-weather security, improved thrust bearing design, metered lubrication and a protected bearing system. Illustrated are installation and maintenance time-reducing features.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Humidity Controller

Development of a new controller for delivering constant humidity air has been announced by Universal Dynamics Corp., Arlington, Va.

According to the company, the unit, called "Humitrol," maintains the relative humidity level within ± ¼ per cent r.h., or better, in an air or gas stream. The unit is composed of a sensing element, control system, and modulating device, all integrally mounted, and is for use in conjunction with dehumidifiers, humidifiers, and air conditioning equipment. It is available in sizes ranging from 20 cfm up.

The control point is set by adjusting a calibrated knob. The unit is claimed to be accurate in a 3 to 98 per cent relative humidity range. Applications include drying ovens for plastic compounds, laboratories, freon handling operations, drug processing, industrial process control, and generally in all installations where a flow of constant humidity air or gas is required.

Tractor Heaters

New hot water heaters have been made available for three models of its tractors, according to a recent announcement by Caterpillar Tractor Co., Peoria, Ill.

The heaters may be used with Caterpillar D9, D8 and D4 tractors equipped with cabs, and are available in two types, recirculating and fresh air. The recirculating type reheats the air supply within the cab, while the fresh air heating system uses outside air. Use of the latter system is said to reduce the possibility of condensation on windows and the need for defrosters, as well as providing a constant supply of fresh air for operator comfort.

The new heaters replace the recirculating type heater formerly available for these tractor models. Both heaters are available either factory-installed on new machines or for installation on machines already in operation, the firm reports.

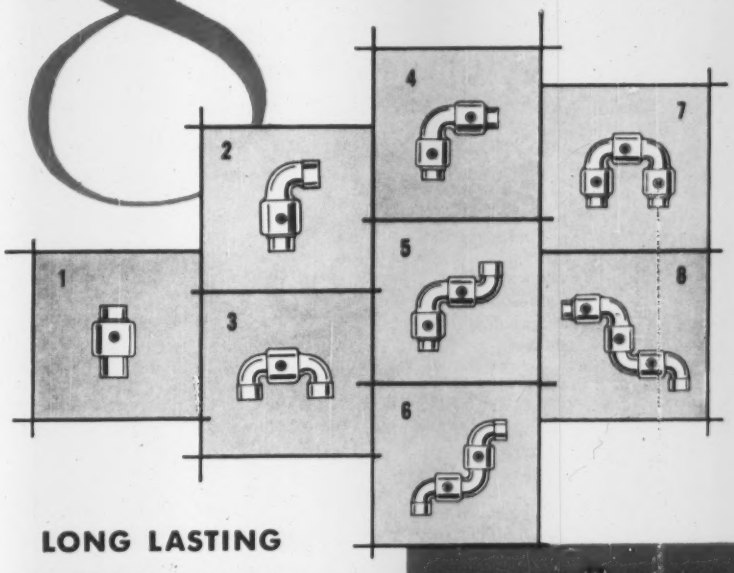
Plastic Lubricant

A new type of lubricant said to possess qualities of a true plastic to achieve long-term lubrication has been developed for use in business machines by Gulf Oil Corp., Pittsburgh, Pa. It is named Plastic Petroleum B.

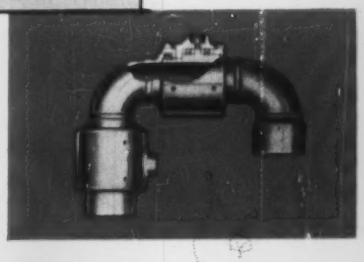
The new product is thixotropic, which means that while being worked it becomes thin and oily and, when working stops, it returns to the consistency of a light grease. Hence it does not run off, or wear off, the parts it protects, the company states.

It will lubricate in a range of temperatures from below freezing to 150 F, thus being adapted to cash registers used in outdoor markets from the tropic to northern regions, to typewriters in military service, and to high speed electric calculators which generate considerable internal heat, the firm reports.

EIGHT BASIC STYLES
OVER 500 MODELS



LONG LASTING
CONTINENTAL-EMSCO
SWIVEL JOINTS



Continental-Emsco Swivel Joints are manufactured in all popular sizes for practically every type of service; from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°. You can service a Continental-Emsco Swivel Joint without removing it from the line. Just break the joint as you would a pipe union. Packing is then readily accessible and can be replaced when necessary. No expensive returns to factory for repair.

Call or write today for complete information.

Grooved packing for high temperatures or corrosive services.

Lip type packing for both high and low pressures.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Paper Roll Clamp

The development of an improved paper roll clamp attachment for lift trucks, designed to give a greater equalization of clamping pressure on the roll, has been announced by Yale Materials Handling Div., Yale & Towne Mfg. Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa.

This even distribution of the holding force permits faster handling of rolls of paper by making it easier to obtain a positive, safe grip on the roll, the company states.

Dual, 10-in. long by 8-in. wide pads on each arm of the attachment distribute the clamping pressure evenly along the sides of the load. The portion of the clamp arm between the two pads is slotted to give a small degree of flexibility in the arm itself which further aids in the equalization of pressure.

The new clamp can handle rolls ranging from 10 to 60 in. in diam. Rolls from 28 to 60 in. in diam can be handled with clamp arms in the normal position. The firm says simple mechanical adjustment of one arm permits handling of smaller rolls.

Each arm of the clamp is individually controlled permitting lateral adjustment and a sideshifting effect when handling rolls of less diameter than the maximum clamp range.

The load can be maneuvered out of tight places by resting it on the floor or another load while one arm is extended to its lateral limit and then the other used to shift the load and restore clamping pressure for lifting.

The new attachment is built in capacities from 1250 to 6500 lb.

All-Plastic Valve

Vanton Pump & Equipment Corp., 201 Sweetland Ave., Hillside, N. J. announces that it is making the first all-plastic gate valve designed to meet the problems of conveying corrosive and abrasive liquids in lines that cannot be chemically contaminated.

Design of the new product, called the Flex-Plug gate valve, is said to combine both the straight-through flow, non-pressure drop characteristic of a gate valve and the throttling flow-control feature of a globe valve.

The valve is available in 1 and 2-in. sizes with screwed ends. The valve offered in both RVC rigid polyvinyl chloride and styrene-copolymer, operates by the closure of a conically shaped plug with a resilient and removable synthetic cap on the inside of the body. When fully open there is no obstruction to fluid flow. When partially open, the developed curved design of the flexible cap and plug allows for minimum turbulence with throttled controlled flow, the firm states.

The flexible cap is available in either Buna N, neoprene or Hypalon with Kel F elastomer for special applications. The PVC line resists temperatures up to 140 F; the styrene-copolymer up to 170 F.

High Temperature Pyrometer

A new high temperature measuring instrument, introduced by the Instrument Div., Robertshaw-Fulton Controls Co. 2920 N. 4th St., Philadelphia 33, measures the temperature of hot objects without touching them.

The instrument, called the land radiation pyrometer, measures the radiant energy given off by hot objects. The instrument is said to be particularly useful in measuring the temperature of objects beyond the normal range of thermocouples, moving objects, and where corrosion or other conditions eliminate the use of conventional resistance temperature detectors.

Temperature measurement with the pyrometer is relatively independent of the distance between the detector and the object being measured, it is stated. Radiation from surfaces in the open, however, will give inaccurate readings unless corrected for variations for emissivity.

In using the new pyrometer, radiation from the hot object is focused on a small aperture in front of a thermopile, consisting of a bank of ten thermocouples connected in series. A variety of lenses, depending on the use, is employed to focus the radiation on the thermopile. Only 2 sec are required for 98 per cent of full reading; however, a special thermopile may be obtained for 98 per cent of full reading in 0.6 sec.

Several models are available for ranges between 1000 and 3300 F. All instruments are sealed against dust and fumes. Two protective air purge fittings are available for use with any model. The first projects a beam of air along the line of focus to prevent dust and fumes from obscuring the screen or lens. The second purge fitting used with closed end sighting tubes permits the escape of air from inside the housing, thereby protecting the lens from condensate.

A variety of accessory equipment is available for specialized application to steel mills, furnaces, kilns, and salt bath installations.

Vacuum Induction Furnace

A 50- to 300-lb vacuum induction melting furnace is now available from the Rochester Div., Consolidated Electrodynamics Corp. 1775 Mt. Reade Blvd., Rochester, N.Y. Designated Type FIM-300, the furnace has and 8-ft long, 5-ft diam chamber, a 2900-l-per-sec diffusion-ejector pump, a 310-cfm mechanical pump, and a control center.

Standard equipment includes two observation windows, a bridge breaker, and a sight tube. Two spare ball-and-socket joints are provided for use with such accessories as a thermocouple assembly, a sampling device, or an optical sight tube. A 12-in. blanked-off flange over the crucible is said to allow easy and inexpensive addition of a bulk-charging chamber. The top third of the chamber is cooled by a water jacket and the remainder by copper water coils.

Manufacturing at Marquardt

by
Roy E. Marquardt
President

Another barrier – the PRODUCIBILITY BARRIER – is currently being penetrated by Marquardt engineers. What do we mean by PRODUCIBILITY BARRIER?

Advanced designs for supersonic ramjet powerplants coming from the drawing boards call for strength to weight ratios and high-precision tolerances previously unobtainable. New high-temperature alloys are meeting the metallurgical demands, but do not readily lend themselves to conventional machining and fabricating techniques.

Those members of the Marquardt team charged with pioneering new production methods comprise our Van Nuys Manufacturing Division. Here – under the direction of John S. Liefeld – creativeness and imagination join forces with a thorough understanding of standard shop practices to produce acceptable hardware. But management realizes that to do his best work the engineer must be supplied with the most up-to-date tools of his trade.

Exemplifying our continuing efforts to this end: a specially designed, half-million dollar roll-former is being added to the company's ever-expanding production facilities. This machine will be capable of spinning conical, tubular, venturi, and parabolic configurations of a size heretofore considered impossible or impractical to fabricate as a single piece. A completely safe, close-up view of the actual metal forming will be afforded the operator by means of two closed-circuit TV cameras mounted on the machine frame.

We are also acquiring other automatic machines – numerically controlled units capable of multiplying the output of their manually operated counterparts several times. Utilizing punched and magnetic tape, these machines are expected to greatly expand the scope of Manufacturing Engineering.

Another of the modern production techniques at Marquardt puts to use modern optics equipment for the construction of prototype engines.

At Marquardt, the engineer will find a broad range of challenging assignments and the opportunity to further his career through supplemental educational programs.

Within this Division, engineering openings exist now for:

METHODS ENGINEERS — PROCESS ENGINEERS
TOOL ENGINEERS — AUTOMATION ENGINEERS
NUMERICAL CONTROL ENGINEERS

For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Dale, Professional Personnel, today.

Roy E Marquardt

marquardt AIRCRAFT CO.
VAN NUYS, CALIFORNIA — OGDEN, UTAH
FIRST IN RAMJETS

To Manufacturing Engineers Facing an ENGINEER | BARRIER *

Shown here: John S. Liefeld, Director Van Nuys Manufacturing Division

Marquardt Means Opportunity – Manufacturing engineers no longer need feel stymied because of the lack of up-to-date equipment. At Marquardt Aircraft – the company where an ENGINEER/BARRIER* has never existed – you will find the most advanced tools of your trade. Look to your future by looking to Marquardt, today. Address your inquiries to Jim Dale, Professional Personnel, 16550 Saticoy Street, Van Nuys, California.

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Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours within the one, new NATIONAL AIROIL Dual Stage Burner.

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Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed descriptions, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

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FURNACE RELIEF DOORS
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SPECIAL REFRACTORY SHAPES

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NATIONAL AIROIL BURNER CO., INC.

1239 E. Sedgley Ave., Philadelphia 34, Pa.

Southwestern Div.: 2512 So. Blvd., Houston 6, Texas

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

The mold well is flanged and can be constructed at any desired depth and readily interchanged with bolt-on accessories. The 36-in. diam of the mold well facilitates pouring of large-diameter molds as well as adding an accessory mold table. The standard well accommodates molds 48 in. in height. The mold table permits 42-in. molds.

Four independently controlled charging cups are included for either alloy addition or base charging. They have a combined volume of 268 cu in. equal in volume to a nominal 50-lb crucible. The cups are of the tipping type to allow regulation of the rate and amount of additions.

According to the company, charges to the crucible are handled by a solenoid-controlled feeder, which can handle materials from large lumps to fine dust. Flow can be varied from a rush to slow or instantaneous cut-off.

The crucible is tilted by an air-motor power unit remotely controlled from the observation window at the side of the vacuum chamber. Tilting speed is variable in either direction and the crucible is held in any position by a fail-safe braking system, the firm states. The crucible can be back-tilted 20 deg to facilitate melting bridge or skull formations.

The control center includes a Pirani-type gage, controls for all pneumatic valves, a schematic diagram of the pumping lines, and space for addition of accessory equipment. Pilot lights on rotary knobs indicate valve positions. The three-station Pirani-type gage provides continuous pressure indication from 100 mm to 1 micron Hg within the main vacuum chamber, in the forepressure line of the vapor pump, and on the inlet side of the mechanical forepump.

The basic version of the FIM-300 has a capacity of 200 lb, but this can be increased to 300 lb by addition of a second diffusion-ejector pump to a blanked-off 12-in. nozzle at the back of the chamber.

EGYPTIAN DEITIES, Fatimas and Harems

No, these aren't out of Arabian Nights, but were contemporaries of Murads, Condaxes, Richmond Straight Cuts and Sweet Caporals — all popular cigarettes of fifty years ago. Their sale was still illegal in several states, but where you could buy them they cost from 10c to 15c a package of 20 down south (where the popular brands used Virginia tobacco) to 15c to 25c a box of 10 up North (where straight Turkish tobaccos and cork tips were favored). They were a relatively new "fad" and considered by many to be objectionably "sporty".

In the ensuing fifty years the popular attitude towards cigarettes has changed considerably — and so have the cigarettes. As cigarette manufacturers have learned how to improve their product over the years, so have we learned a *lot* more about making better gears than anyone knew back in 1907. In fact, we've made a lot of progress just in the past ten or fifteen years. What about *your* present source of custom gears? A re-examination may show that it will pay you now more than ever to rely on Cincinnati Gear for your custom gear requirements.

THE CINCINNATI GEAR CO.

CINCINNATI 27, OHIO

Fifty Years of "Gears — Good Gears Only"

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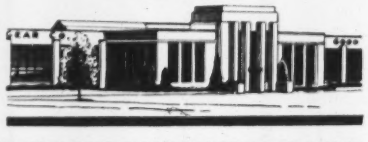

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29 West 39th Street

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IFC	15	30	41	54	68	81B	90	103	116	127TL
1	16–17	31	42	56	69	82L	91	104	118	127R
2	18	32	43	57	72L	83	92–93	106	119	128TR
3	19	33	44	59	72R	84T	94	107	120	128BR
4–5	20	34	45	60	75	84B	95	108	121	129
6–7	21	35	46	61	76	85	96	110	122	130
8–9	22–23	36	47	62	77	86	97	111	123	139
10–11	24	37	48	63	78L	87R	98	112	125	141
12	25	38	49	65	80T	88L	99	113	126L	142
13	26–27	39	51	66L	80B	88R	100	114	126TR	IBC
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4–5	20	34	45	60	75	84B	95	108	121	129
6–7	21	35	46	61	76	85	96	110	122	130
8–9	22–23	36	47	62	77	86	97	111	123	139
10–11	24	37	48	63	78L	87R	98	112	125	141
12	25	38	49	65	80T	88L	99	113	126L	142
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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Shaft-Mounted Pump

A new sealed gear pump in which fluid flow is always in the same direction regardless of shaft rotation has been developed by engineers of Bijur Lubricating Corp., Rochelle Park, N. J.

The $2^1/_2$-in. reversible pump can be mounted on any machine requiring fluid circulation for lubrication or other purposes, the company states. Designed to be driven from a rotating machine shaft either directly or through a gear chain drive of suitable ratio, the pump is applicable to machine tools or any other machine requiring flood lubrication over gear trains, chains or cams. It is intended for recirculation pump systems.

It has a special lip-style seal, located on the drive shaft, which will withstand back pressures up to 20 psi. Operational failure is said to be eliminated by the venting of pressure to the inlet of the pump by means of a pressure relief system. A built-in-relief valve prevents loading the seal above rated limitations.

The pump allows reversal of drive direction while maintaining the same direction of oil flow. It is designed to be driven from a rotating shaft whose direction of drive reverses during machine operation.

A piston-type valve in the base of this pump transfers as the direction of drive reverses, keeping the direction of flow constant by connecting the proper outlet from the pump gears to the pump outlet. An exterior inlet check valve is provided for positive action of the reversing valve. The parts are accurately dowelled together for proper lineup.

The discharge of the reversible pump is 50 cc per minute at 100 rpm, and its recommended speed range is 20 to 500 rpm. Shaft seal is assembled $^1/_{16}$ in. below the top surface of the pump. This pocket provides a pilot counterbore to center the drive shaft with the mating machine shaft if a tongue drive is preferred.

The pump is capable of operating at discharge pressure of 150 psi with approximately 80 per cent efficiency. Overall dimensions are approximately $2^1/_2$ in. diam and $1^1/_2$ in. in height. It is constructed of close grained iron with steel pump gears. The drive shaft is provided with a flat for set screw. Mounting holes permit installation either on a bracket or in any position desired on the machine surface, in order to simplify overall machine design.

In parts like these

KENNAMETAL* K501

EQUALS the Noble Metals in Corrosion Resistance...

BETTERS them in Economy and Resistance to Wear!

In the chemical field, and also in the food, paint, petroleum, oil refining, paper and atomic energy industries, equipment components like the ones shown above are often exposed to extremely severe corrosion.

When—as often happens—the corrosive attack is complicated by excessive wear conditions, and when contamination of the batches handled must be avoided, the designer and plant engineer have a real problem in materials selections.

Kennametal K501 has proven itself an extremely effective and economical answer, as it combines a high degree of corrosion resistance with unusual wear resistance, that eliminates frequent replacement, and greatly reduces contamination.

Laboratory tests show no measurable weight loss of a K501 sample after five days in boiling 5% HNO_3 and 5% H_2SO_4. Loss was only 74/mg/dm/day in boiling 5% HCl.

Hardness, RA is 91.0 minimum; transverse rupture strength is 125,000 psi minimum; and, density is 15.10 minimum. The material can be formed from powders to very close tolerances, and then ground to finishes that have proved adequate in seal applications demanding a flatness of two light bands, and a surface roughness of about one microinch rmp.

If you have use for valve parts, balls and seats, guides, wear rails, slitting and cutting parts, non-lubricated guides and bushings, metering orifices, sealing rings, in applications where corrosion and wear are problems, ask for full information about Kennametal's K501. Just write to: KENNAMETAL INC., Dept. ME, Latrobe, Pennsylvania.

*Trademark of a series of hard carbide alloys of tungsten, tungsten-titanium and tantalum.

C-3067

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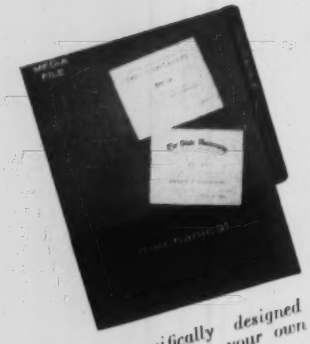

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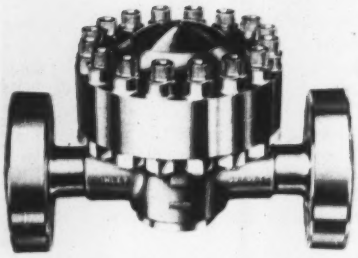

Pressure Regulator

A new Servo-Dome pressure regulator, just introduced by Accessory Products Corp., Dept. X-38, 616 W. Whittier Blvd., Whittier, Calif., incorporates unique new features which provide exceptional accuracy in flow and/or pressure control.

Performance features include identical line and orifice sizes from 1/4 to 3 in.; inlet pressures from 0 to 6000 psi; outlet pressures from 0 to 5500 psi; zero leakage through positive shut-off; balanced poppet; direct action which eliminates pilot control. The regulator has temperature range of −65 to +250 F. It can be supplied with flanged, pipe, tube or custom end connections, internal or downstream sensing control, external or self-contained dome loading. Burst pressure is four times rated pressure.

The unit is available in stainless steel, aluminum, alloy steel, and bronze.

BUSINESS NOTES

Announces New Plant

Construction is expected shortly on a new Lebanon, N. H., plant for the Split Ballbearing Div. Miniature Precision Bearings, Inc., it is announced by the company.

The plant, which will be built at an estimated cost of $350,000 will cover approximately 30,000 sq ft. This will more than triple the floor space of the present Split Ballbearing facility and is expected to double the workforce of 75 employees.

Two Divisions Move

Norden-Ketay's two Long Island divisions, Precision Components Div. and Gyromechanisms Div. are moving to new quarters.

A 31,000 sq ft addition to the corporation's Precision Component at Commack represents a 36 per cent increase to that division and brings total area to over 85,000 sq ft. Gyromechanisms moves to a new 17,000 sq ft building at Huntington Station.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Plastic Pipe

Entrance of A. M. Byers Co., Clark Bldg., Pittsburgh, Pa., into the plastic pipe field, on a national basis, with its own line of PVC pipe for industrial applications is announced.

The sale of the pipe—in sizes 1/4 to 6 in.—is being handled by the company's present technical staff of field service engineers. It is being merchandised, with company support, through Byers distributors and—where warranted—is sold directly to industry.

Builds Bearing Plant

Barden Corp., manufacturer of precision ball bearings, has begun construction of a $2,000,000 instrument precision ball bearing plant in Danbury, Conn.

Building plans call for erection of a 125,000 sq ft manufacturing plant to be completed next June. The plant will be one of the largest in the country devoted exclusively to the design and production of instrument precision ball bearings, it is reported.

LATEST CATALOGS

Welded Tubing

An eight-page folder, No. TB-419, published by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa., explains the advantages offered by the use of electric resistance welded mechanical tubing. It supplies information on the mechanical properties and lists the various size tolerances to which the tubing is normally produced.

Tube, Bar Stock

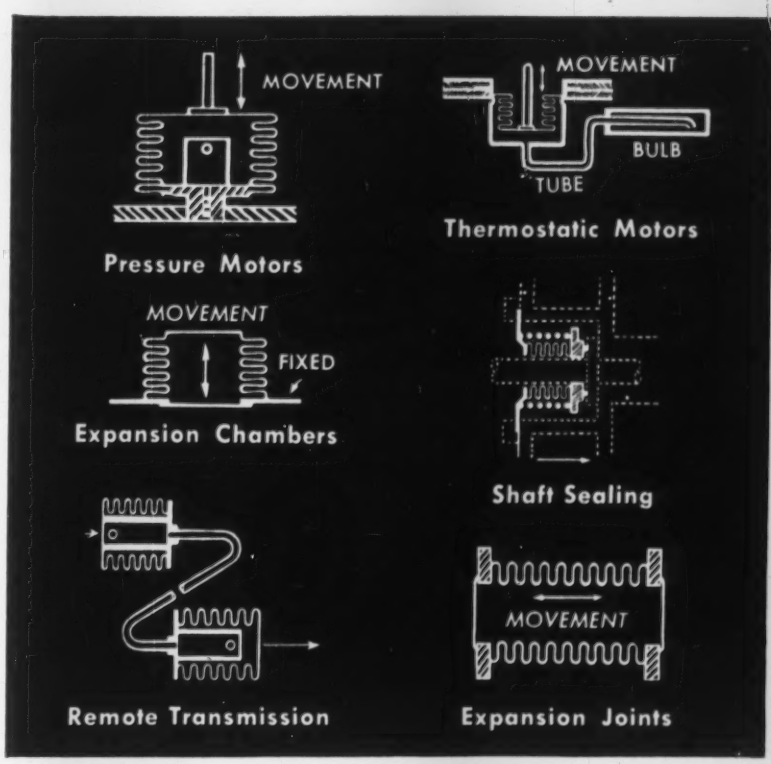
Bulletin No. 156, titled "8 Reasons," gives information on the standard bar and tube stock now offered by Centrifugally Cast Products Div., Shenango Furnace Co., Dover, Ohio.

Included are GC meehanite metal, GA meehanite metal and Type No. 1 Ni-Resist. In addition to illustrating typical uses and outlining the particular features of these materials, the bulletin contains a physical properties chart.

V-Belt Production

A booklet describing the machines and processes used in the production of V-belts has been issued by the Goodyear Tire & Rubber Co., Akron 16, Ohio.

Rubber compounding, preparation of fabric, building steps, curing and finishing are subjects for one-page descriptions of V-belt manufacturing operations.



ELIMINATE DESIGN "WEAK SPOTS" WITH Bridgeport SEAMLESS BELLOWS

The simple construction, straightforward operation, and light weight of Bridgeport seamless metal bellows make them the best answer for many temperature, pressure, and mechanical design problems. Hydraulically formed without soldered seams, they provide added strength and precision in shaft sealing, in obtaining controlled movement, in absorbing expansion or shock, in maintaining equal or differential pressures, and in transmitting motion remotely.

Bridgeport also offers two plus factors to make the most of any bellows application. Through integrated engineering of the bellows and all accessories, Bridgeport can supply complete bellows assemblies of many types, sizes, and metals. Ultra-modern production and quality control facilities assure increased uniformity and cost savings.

SEND FOR BELLOWS BULLETIN-K

Mr. Controls

Robertshaw-Fulton CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION

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Variable SPEED PULLEYS

SELECT-O-SPEED TRANSMISSIONS

Save You Money

HERE'S WHY:

- ECONOMICAL IN COST compared to other variable speed transmission equipment. Simple in design but rugged in construction to give you long dependable service.
- EASILY INSTALLED on new or old equipment. Just as easy to operate. Finger-tip adjustment gives the right speed instantly.
- MAINTENANCE IS NEGLIGIBLE. No complicated mechanisms to get out of order. All parts can be readily inspected. Belts can be quickly adjusted or replaced.

Lovejoy Variable Speed Pulleys

are available in a complete range of sizes from fractional to 15 hp., ratios to 3 to 1.

Shown is a typical Lovejoy countershaft unit controlling speed of automatic spring coiler.

Lovejoy Select-O-Speed Transmissions

can be supplied with hand wheel or lever control. Fractional to 5 hp., ratios to 10 to 1.

This Lovejoy Select-O-Speed is used to control the speed of a printing press.

For your variable speed application, there is a type and size Lovejoy unit that will give you initial economy, dependable performance and long service life.

GET FULL DETAILS NOW!

Request Catalog

LOVEJOY FLEXIBLE COUPLING CO.

4832 W. LAKE STREET • CHICAGO 44, ILLINOIS

Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Copper, Brass Stock

A tabbed, 60-page copper and brass warehouse stock list has been released by American Brass Co., Dept RS, Waterbury 20, Conn.

Included are all items and sizes carried in stock for immediate shipment from the company's warehouses at Chicago, Cleveland, Milwaukee, Philadelphia and Providence.

Crystal Filters

A four-page catalog by Hycon Eastern, Inc., 75 Cambridge Pkwy, Cambridge 42, Mass. summarizes major characteristics of standard crystal filters. Specifications, outline drawings, a typical characteristic curve and a circuit diagram are shown.

Engineering Services

A six-page brochure published by Allstates Design & Development Co., Inc., Trenton, N. J., describes engineering and design services for alleviating peak loads on existing engineering departments and supplying specialized abilities from division offices in seven cities.

Thermostatic Valve

Release of Bulletin No. BCA-2 has been announced by Lawler Automatic Controls, Inc. Mount Vernon, N. Y.

The bulletin gives descriptive and engineering data on the firm's BCA concealed thermostatic shower mixing valve.

Mill Products

Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago Ill., announces its 1958 catalog on mill products.

Included is data on extrusions, rod, bar, wire, sheet, plate, pig ingot, billet, forgings, and industrial foil. Mechanical and physical properties as well as information on processing and fabricating aluminum is included.

Pipe Coating Plant

An eight-page brochure available from Southern Pipe Coating Co., 795 Peachtree St. N.E., Atlanta 8, Ga., describes the firm's facilities for cleaning, coating and wrapping pipe in all sizes from 3/4 to 12 in. in its new Atlanta plant.

Drawings illustrate various stages in the wrapping process, and a description is given of the Holiday detection test and other controls which assure that pipe is evenly coated and completely protected. A sketch shows the company's 17-acre yard for storage of bare and coated pipe. In-transit privileges and the company's fleet of trucks for delivery anywhere in the Southeast are described.

Air, Hydraulic Cylinders

A 12-page catalog of air and hydraulic cylinders has been released by Petch Mfg. Co., 463 York St., Detroit, Mich.

It includes information and engineering specifications on air and low pressure hydraulic, high pressure hydraulic, Pemaco air and hydraulic, automation standard air and hydraulic cylinders in sizes of 1 to 10 in.

Induction Heating

A 60 cycle induction heater bulletin describing developments in induction heating of aluminum, copper, brass, and steel has been released by the Magnethermic Corp., 3990 Simon Rd., Youngstown, Ohio.

The eight-page bulletin includes installation photographs and a convenient billet heater selection chart for aluminum. The advantages of 60 cycle induction heating of copper and brass are featured showing production arrangements now available with standard induction billet heaters to handle most diversified production requirements. 60 cycle steel billet heating installations for extrusion, forging and stage heating are described.

VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

1954 **$5.00**

(20% Discount to ASME Members)

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 W. 39th St. New York, 18.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Power Plant Valves

Design, construction, and testing of a new high pressure-temperature globe type valve for the Public Service Electric and Gas Co., 450,000 kw generating station at Linden, N. J., are discussed in the current issue of Valve Values, published by Edward Valves, Inc., subsidiary of Rockwell Mfg. Co., East Chicago, Ind.

Trash Rakes

S. Morgan Smith Co., York, Pa., announces bulletin 158A, describing self-dumping trash rack rakes of log-grapple and regular types.

The two new designs are an addition to the firm's line of standard Leonard rake designs. Self-dumping features, larger raking capacity and greater clear opening are claimed to provide advantages for pumping stations, steam and hydro-electric power plant water intakes.

Hard-facing Alloys

A revised issue of a booklet covering hard-facing alloys in coils is available from Haynes Stellite Co., Div. Union Carbide Corp., 420 Lexington Ave., New York 17. The eight-page booklet describes the chemical composition, some properties, typical applications, and application procedures for six iron-base alloys produced in drawn tube rod form, and for Haystellite cast tungsten carbide rod which is an ordinary tube rod that is not drawn. Both types of rods are available in coils.

Rust Prevention Systems

A four-page brochure outlining applications and advantages of the firm's rust prevention system is available from L. Sonneborn Sons, Inc., Building Products Div., Dept. EE, 404 Fourth Ave., New York, 16.

It includes information on where, when, and how to use SRP 75 primer for priming rusted surfaces; and SRP 87 finish coat, which adheres to and coats metal surfaces with a protective finish. It tells how these coatings provide durability and elasticity in contact with the corrosive elements. Results of adhesion, immersion, fume, electrolytic breakdown accelerated weatherometer, and field performance tests are also pointed out.

Lifter-Dumper

An eight-page catalog on its line of skip hoist multi-purpose dumpers has been published by Essex Conveyors, Inc., 165 Franklin Ave., Nutley 10, N.J.

The book is illustrated with photos of applications of the Cesco dumpers in various industries handling bags, boxes, bulk, drums, and free flowing material. As much as 75,000 lb per hour can be handled by the dumper, the manufacturer states.

ENGINEERS: *Electronic & Mechanical*
Physicists

MELPAR'S GROWTH CONTINUES

Healthy growth is steady and consistent, rather than explosive. Ours over the past 11 years has seen us double in size every 18 months. Today our 4000-man staff is engaged in 112 diversified electronic R & D projects, as well as weapons systems evaluation in several fields.

This continued expansion creates higher level openings for which you may compete strictly on the basis of your ability. At Melpar emphasis is placed on recognition of the individual and his creative contributions. You will enjoy a high degree of freedom to accomplish your assignments, and red tape and administrative detail are kept to a minimum.

Each of our three laboratories in the Washington, D. C., and Boston areas is well-equipped, geared to both present and future needs. Housing, recreational and cultural facilities available in both communities will make living gracious and enriching for you and your family.

Check your field of interest from the list below. Qualified candidates will be invited to visit Melpar as our guests.

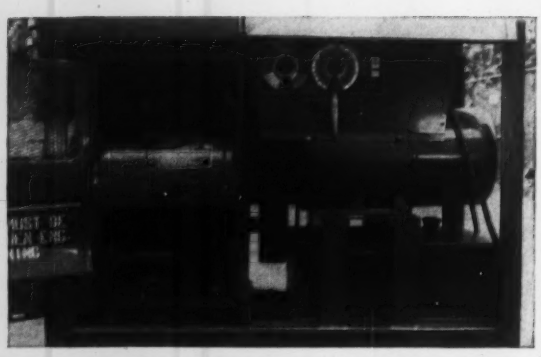
Openings exist in these fields:

	FALLS CHURCH 10 miles from Washington, D. C.	BOSTON	WATERTOWN Suburb of Boston
Weapons Systems Evaluation			
UHF-VHF Circuit Design			
Servo-mechanisms			
Electronic Countermeasures			
Computer Programming			
Antenna Design			
Systems Analysis			
Digital and Analog Computers Design			
Transistor Circuits			
Microwave Component Design			
Radar and Fire Control Systems Design			
Microwave IF and RF			
Weapons Systems Evaluation			
Printed Circuit Techniques			
Digital and Analog Computer Techniques			

Write: Technical Personnel Representative

MELPAR *Incorporated*
A Subsidiary of Westinghouse Air Brake Co.
3421 Arlington Boulevard, Falls Church, Virgina.
10 miles from Washington, D. C.

3,143 operating hours *with only minor adjustments with this 400 amp.*



WISCONSIN-POWERED WELDER

On-the-job service is what counts most in an engine. Here, for example, is a brief summary of a service report covering the performance of the Model VR4D 56 hp. Wisconsin Heavy-Duty AIR-COOLED Power Unit which drives the 400 Ampere Arc Welder illustrated above:

"Has operated exceedingly well . . . approximately 3143 operating hours . . . maintenance has been negligible after a few minor adjustments; appreciate fact that servicing is so simple; we are free of anti-freeze . . . no fooling with gadgets of water-cooled engines."

This is another typical case of outstanding service delivered by Wisconsin Heavy-Duty Air-Cooled Engines on many kinds of equipment. Basic load-holding High Torque, heavy-duty design and construction in all details, foolproof all-weather Air-Cooling and *exclusive specialization* in the design and manufacture of AIR-COOLED Engines are some of the factors that are responsible for Wisconsin Engine preference wherever dependable, economical power is required.

You can't do better than to specify "Wisconsin Power" for your equipment. Write for Wisconsin Engine Bulletin S-212.

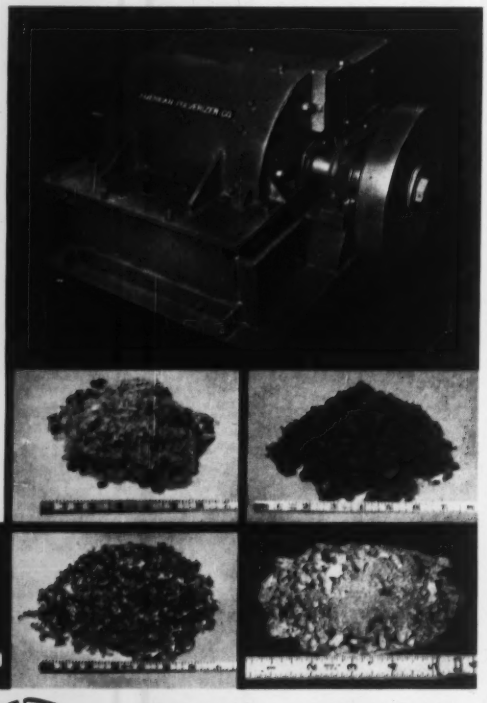
WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN

FOR REDUCING OR SALVAGING MATERIALS *it's profitable to consult*

American

Got a waste product problem? Got tons or pounds of chemicals, plastics, ceramics, metallics, or **any other material** you'd like to reduce for resale or reuse?

Send samples of any material you desire to American, and let our engineers apply their reduction experience to your particular reduction or salvage problem. No obligation. Send samplies, not over 50 lbs., F.O.B. St. Louis.



American **PULVERIZER COMPANY**
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1541 MACKLIND AVE. SAINT LOUIS 10, MO.

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Electronic Weighing

Streeter-Amet Co., Grayslake, Ill., has issued a new bulletin describing electronic weighing by its electronic crane scale.

It shows how this scale combines weighing and transportation operations. The exact weight of heavy loads may be recorded on tape, ticket or cards in a cab located away from the weighing area.

Variable Speed V-Belts

A 24-page variable speed V-belt catalog and reference handbook has been made available by Industrial Div., The Dayton Rubber Co., Dayton 1, Ohio.

The catalog gives cross-reference information on every variable speed V-belt for every type or make of unit. It also contains complete interchange listings including drive data and part number listings of the manufacturers.

Power Packs

A four page, illustrated catalog, Form 8-425, describing the new hydraulic power packs for simultaneous operation of up to four fastener installation tools is now available from Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich.

Descriptions of both the Model 800 power pack for use with two pull tools and Model 801 power pack for use with up to four pull tools are included in the new catalog. Features and specifications are outlined and illustrated.

Testing Machine

Bulletin 106, revised to incorporate new operating information on the Model LFW-1 lubricant-friction-wear testing machine, has been released by Alpha Molykote Corp., Stamford, Conn.

Included in the new bulletin is a description of the machine's operation as well as a revised list of specifications in the English and metric systems. The details of the specimen holder and lubricant reservoir are shown in the new photograph.

Vacuum Valves

NRC Equipment Corp., 160 Charlemont St., Newton 61, Mass., has issued a 32-page engineering manual describing and illustrating a comprehensive line of high vacuum valves.

Included is a discussion of the requirements imposed by high vacuum service which often are combined with severe corrosion conditions, high temperature, vibration and severe mechanical stresses. High vacuum valves described include globe, gate, swing disk, slide and a recently announced ball closure. They are available in steel, stainless steel, bronze, aluminum and polyvinyl chloride ranging in size from $\frac{1}{8}$ to 20 in.

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Dehumidifiers

Anders-Lykens Corp., Div., Milton Roy Co., 1328 E. Mermaid Lane, Philadelphia 18, Pa., has published Bulletin 857, covering instrument air dryers.

The four-page bulletin describes adsorptive type, automatically regenerated dryers with capacities to 125 standard cu ft per min at 90 F and 100 psig. The bulletin describes and illustrates the operation of the dryers and contains specifications and a sizing nomograph.

Heat Treatment

A catalog describing the effect of steam atmosphere heat treating on various materials has been released by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

This treatment is being used to lengthen life of high speed steel cutting tools, strengthen powdered iron parts, seal and protect cast iron, make structural steel corrosion-resistant, reduce cleaning costs on nonferrous parts and prevent flex-cracking of molded rubber parts, the company states.

Pulse Generator

A new wide range pulse generator, Type 1006, is illustrated and described in a technical bulletin released by the Electronic Instruments Div., Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa.

The unit discussed in the bulletin produces a stable source of pulses in eight overlapping frequency ranges up to 4.5 mc. Its output may be a continuous train of pulses controlled by selecting one of the eight frequency ranges or a single pulse controlled by pressing a pushbutton on the front panel. The output pulse is either a positive or negative half sine-wave of 0.1 microsecond duration whose amplitude is variable from 8 to 30 v.

Flexible Couplings

A new book describing its line of improved geared flexible couplings has been released by Link-Belt Co., Prudential Plaza, Chicago 1, Ill.

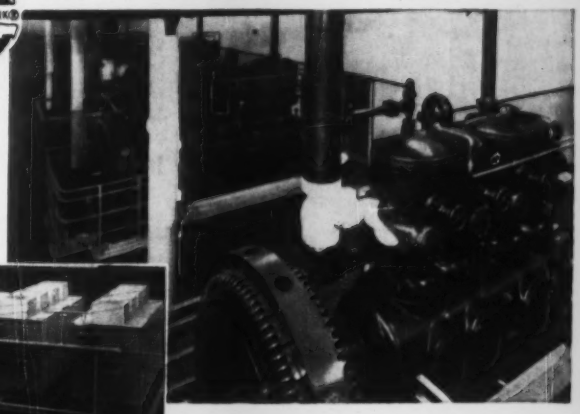
Book 2775 details application and selection data for couplings with maximum bores ranging up to 7 in. and ratings from $2^1/_2$ to 572 hp per 100 rpm. Housing halves are of forged steel solidly joined by hardened and ground socket head through bolts with lock nuts, arranged for one-tool assembly. Effective quad-ring hub seals retain lubricant and exclude dust, water or other destructive matter, the firm states.

LISTEN TO YOUR HEART

AND GIVE A LITTLE MORE

TRADE FRICK MARK®

means SATISFACTION



Right Photo: Three of the Four Frick Compressors in Pittsburgh Brewery.

Bottom Photo: Four 300-ton evaporative condensers at Pittsburgh Brewery.

In 1948 the Pittsburgh (Penna.) Brewing Company installed two 14 by 12 Frick compressors. Since the initial order, the Company has added other Frick equipment until today there are four of these 14 by 12 compressors, three brine coolers and four 300-ton evaporative condensers, plus accessory equipment.

If you need refrigeration for processing, air conditioning, ice making, cold storage, quick freezing or other cooling purposes, you will find Frick equipment and engineering service the ultimate answers. Call your nearest Frick Branch Office or Distributor today.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U. S. A.

THERE'S A WORLD OF DIFFERENCE in Bearings

Promet Engineered Bronze Bearings, Bushings and Wearing Parts absolutely will not powder in severest service, nor cut or stick to the shaft because of temporary lubrication failure. They give longer, trouble-free service or your money back.

Write for free literature and service data sheets or send prints and conditions of operation for recommendations and quotations. No obligation

THE American Crucible PRODUCTS CO.

1403 Oberlin Avenue

Lorain, Ohio, U. S. A.

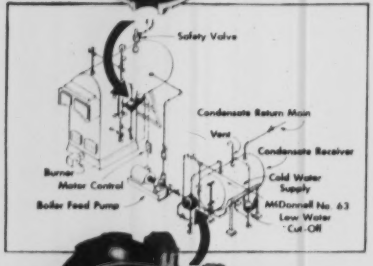
Here's the Great Combination for those...

Medium Pressure Boilers
(up to 150 lbs. psi.)

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

Underwriters Listed
C.S.A. Approval No. 5545

McDONNELL No. 150 PUMP CONTROL



McDONNELL No. 27T MAKE-UP FEEDER

Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

Write for simple installation and wiring diagrams

McDONNELL & MILLER, INC.
3510 N. Spaulding Ave., Chicago 18, Ill.

Pioneering Over Thirty Years

McDONNELL
Boiler Water Level Control and Safety Devices

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Investment-Cast-Metals

A two-color chart tabulating composition and physical properties of alloys commonly used for investment castings is now available from Alloy Precision Castings Co., 3855 W. 150th St., Cleveland 14, Ohio.

Two sets of mechanical properties are delineated. The first is for metal in the as cast- or annealed state; the second is for hardened castings. The metallurgical composition of each alloy is also given in detail. On the reverse side of the chart appear investment casting design specifications covering such items as surface finish, dimensional tolerances, concentricity, cored holes, cast threads.

Ventilator Color Guide

A new color guide for the selection of the best combinations of colors and laminated plastic patterns for Herman Nelson unit ventilator products, has been made available by American Air Filter Co., 215 Central Ave., Louisville 8, Ky.

Seven true color paint samples are included for school unit ventilators and cabinets, along with recommended color combinations and reflective factor of each color. Five full color samples of laminated plastic for top surfaces are also shown. All color patterns are available from stock, according to the manufacturer, and may be used alone or in suggested combinations.

Gas Turbine Engines

Solar Aircraft Co. has published a 24-page brochure describing the company's 500-hp Jupiter gas turbine engines. Copies may be obtained by writing to the company at 2200 Pacific Highway, San Diego 12, Calif.

The brochure contains photographs of actual installations, cutaway views of different engine configurations, performance charts outline drawings and other illustrations. Special sections describe the comparative performance of gas turbine and diesel engines, principles of gas turbine power, components and accessories, and potential applications for the unit.

Plastic Finishing Equipment

An eight-page bulletin has been issued by the Pangborn Corp., Hagerstown, Md., describing its Rotoblast deflashing equipment available for cleaning and finishing of all types of plastic parts.

Containing specification and application data on both the Blastmaster barrel for mass production cleaning of all types of plastic pieces and the Rotoblast table for quick deflashing of fragile parts, the reference bulletin details construction features and operation of the automatic Rotoblast unit which supplies blasting power by centrifugal force.

VIGILANCE

The final victory over cancer will come from the research laboratory.

But there is a more immediate victory at hand today. Many cancers can be cured when detected early and treated promptly. *Vigilance* is the key to this victory.

There are certain signs which might mean cancer. Vigilance in heeding these danger signals could mean victory over cancer for you:

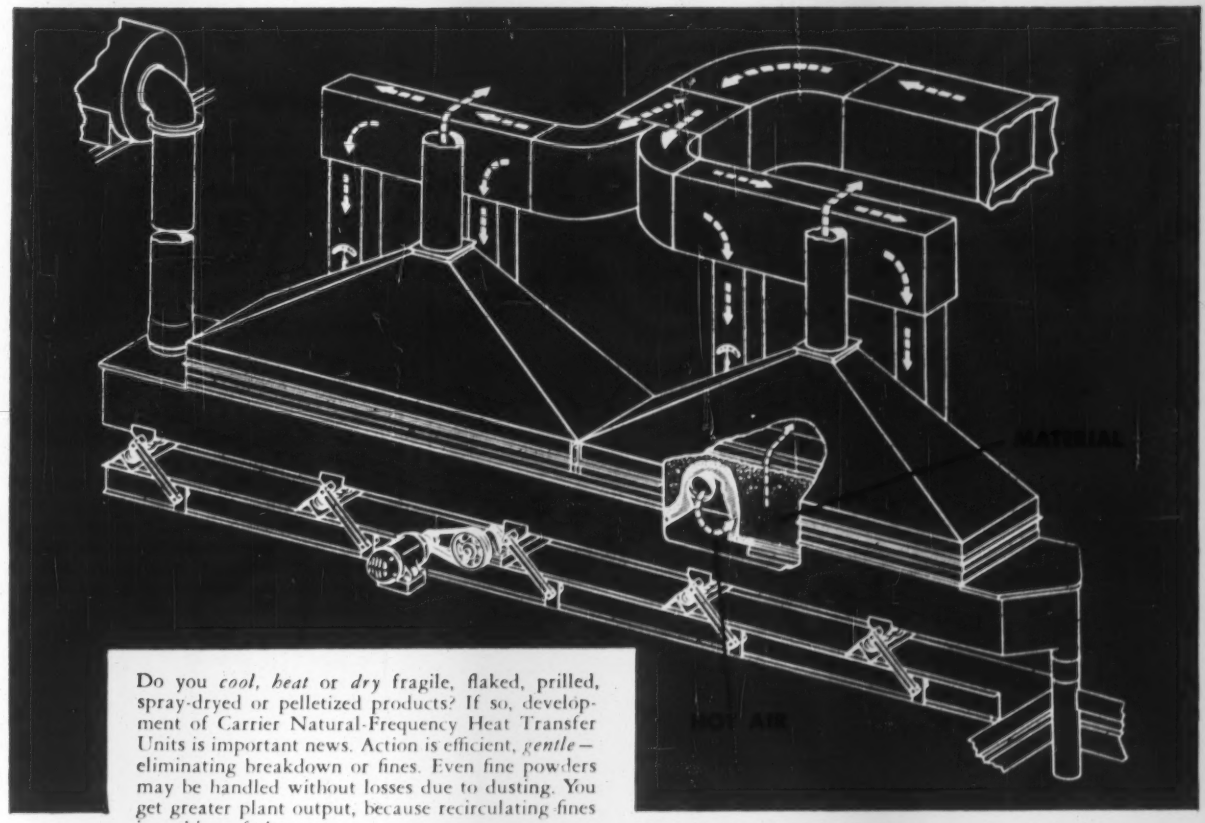
1. Unusual bleeding or discharge.
2. A lump or thickening in the breast or elsewhere.
3. A sore that does not heal.
4. Change in bowel or bladder habits.
5. Hoarseness or cough.
6. Indigestion or difficulty in swallowing.
7. Change in a wart or mole.

If your signal lasts longer than two weeks, go to your doctor to learn if it means cancer.

AMERICAN CANCER SOCIETY

Now! You can *cool, heat, dry* fragile materials —with no product breakdown . . .

CARRIER heat transfer units



Carrier Natural-Frequency Heat Transfer equipment slowly conveys the material being handled across a screen, with the heat transfer media being drawn through the screen and material by an induced draft fan — or forced through the screen and material by a forced draft fan as shown. A stationary or vibrating hood is included to exhaust the air after use.

Do you *cool, heat* or *dry* fragile, flaked, prilled, spray-dryed or pelletized products? If so, development of Carrier Natural-Frequency Heat Transfer Units is important news. Action is efficient, *gentle*— eliminating breakdown or fines. Even fine powders may be handled without losses due to dusting. You get greater plant output, because recirculating fines is a thing of the past.

And look at these other advantages! Carrier heat transfer equipment can screen *and* separate the material being handled *while* cooling, heating or drying. Units which sample continuously while accomplishing heat transfer can also be provided. Drying air may be varied according to temperature, taking advantage of constant and falling rate drying periods. In addition, there is a high degree of uniformity in the finished product.

Carrier offers all these advantages plus such other important features as ease of clean-out; self-cleaning action which prevents contamination between batches; savings on plant equipment headroom because inclined and vertical units can elevate while processing, and a long retention time with start-stop operation.

Get all the facts now. Write today for full information. Carrier Conveyor Corporation, 236-A North Jackson Street, Louisville, Kentucky.

CARRIER
~~NATURAL-FREQUENCY~~®
CONVEYORS

Type A centrifugal basic pump. Suction and discharge in lower half of casing.

45° A NEW SERIES AURORA® TYPE A

Two Stage Diagonally Split Case MULTI-PURPOSE PUMPS 45°

Suited to BOILER FEED, Hot or Volatile Liquids duties etc., etc.

•

Low NPSH Characteristics

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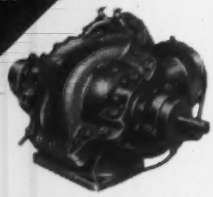
Being Self-Venting, Will NOT VAPOR LOCK

MANY BENEFITS

45° split case offers substantial new advantages while retaining all of the best features of the horizontally split case pumps—in that the entire rotating element can be removed without disturbing piping or disturbing the pump-motor-base alignment. 45° split allows both suction and discharge to be in the bottom half of casing but above the center line of the pump.



Aurora Type AJ Centrifugal Pump with Water Cooled Bearings and Stuffing Boxes

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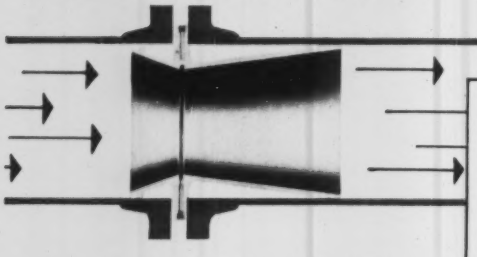
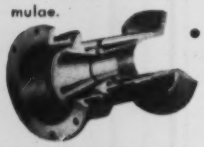
AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
96 LOUCKS STREET • AURORA • ILLINOIS
EXPORT DEPARTMENT — Aurora, Illinois — Cable Address "NYABINT"

NEW TYPE FLOW METER CUTS PRESSURE LOSS BY 93.5%*



Get low cost flow metering with **Builders Dall Flow Tubes** — the primary element with the lowest pressure loss of any velocity-increasing differential producer!

- Greater instrument accuracy through higher differentials at the lowest total head loss.
- Fabricated design allows wide construction material choice to meet exact process specifications.
- All critical surfaces precisely machined to Dall formulae.
- *Enduring accuracy* through self-scouring, durable construction.



CAST DALL FLOW TUBE RECOMMENDED FOR WATER WORKS AND SEWAGE INSTALLATIONS

***Here's How!**

Builders Dall Tube #12D in 12" pipeline — max. differential 80" — max. flow 3900 GPM.	Pressure loss at max. flow— 2" of water
Orifice plate in 12" pipeline for same max. differential and flow	Pressure loss at max. flow— 31" of water
	Pressure loss saving with Dall Flow Tube — 93.5%

(On one installation, this saving produced pumping power cost reduction of $560.00 each year.)

Request Bulletin 115-DM1, from **Builders-Providence, Inc., 382 Harris Avenue, Providence 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Marking Tools, Dies

M. E. Cunningham Co., 1025 Chateau St., Pittsburgh 33, Pa., announces its Catalog 200, illustrating and describing marking tools and devices.

The 45-page booklet includes information on safety steel, a specially developed alloy which is said to reduce spalling and mushrooming, and data on new special marking machines.

Cushioned Valves

A four-page bulletin published by Golden-Anderson Valve Specialty Co., 1223 Ridge Ave., Pittsburgh 33, Pa. shows various piping and valve arrangements for such applications as supply water to mill, accurate water level control in reservoirs, emergency fire protection and isolating part or all of a system.

Powdered Acid

Properties and uses of Drycid, a recently introduced powdered acid scale and rust remover, are described in a service report published by Oakite Products, Inc., 157 Rector St., New York 6.

The report points out convenience inherent in shipping, storing, and using a powdered rather than liquid acid; the lack of acid fumes; and the material's increased safety on various metals. One of the major advantages discussed is Drycid's safety when used to descale systems containing dissimilar metals.

Outdoor Fork Trucks

Specifications and operating characteristics of the Clarklift Y350 and Y400, outdoor fork trucks of 35,000 and 40,000 lb capacities, are contained in a six-page catalog available from Industrial Truck Div., Clark Equipment Co., Battle Creek, Mich.

Details of dimensions, travel and lift speeds, and various components are given. Charts indicate capacities at varying load centers and upright dimensions. Photographs illustrate some construction features and show several possible job applications.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

1956 $1.00 20% Discount to ASME members

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th St., New York 18, N. Y.

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Clutches, Brakes

Warner Electric Brake & Clutch Co., Beloit, Wis. announces new Catalog Digest WEB 6292 giving facts about electric brakes, clutches, and controls for miniature mechanisms or high torque machine drives.

Controls Manual

Eight specific slasher-size room control systems are described in a new manual available from the Powers Regulator Co., manufacturer of process controls.

The sixty-four-page manual describes systems and equipment for control of temperatures of size cooking and storage kettles, size boxes, overwaxers and slashers. Level control systems for size boxes and cookers are also described.

Ask for "Slasher and Size Room Controls Manual" from the Powers Regulator Co., 3434 Oakton St., Skokie, Ill., or from the Powers Regulator Co. of Canada, Ltd., 15 Torbarrie Road, Downsview, Ontario.

Saturable Power Reactors

A 32-page bulletin, F-8383, designed as an application guide for the use of saturable power reactors is available from Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.

The new publication discusses saturable power reactor uses, turn down characteristics and the application of automatic control to these units. With proper temperature measuring instruments and a d-c source, usually a magnetic amplifier, it is possible and practical to use a saturable reactor to control a-c power to furnaces, heaters, and other equipment supplying resistive loads, it is stated.

Ball Valve

Worcester Valve Co., 16 Parker St., Worcester, Mass., announces Catalog No. WV454, illustrating and describing its Econ-O-Miser ball valve.

The four-page bulletin includes comparative labor and materials cost breakdowns of the new valve and bronze gate valves. Dimensions are diagrammed and pressure-temperature ratings are included.

Chemical Solvents

Kano Laboratories, 1000 S. Thompson Lane, Nashville 11, Tenn., has available a four-page folder listing maintenance ideas for approximately 100 different types of machines, products, and parts.

The firm manufactures chemical solvents for loosening frozen parts and speciality lubricants and coatings for protecting equipment in home and industry. The firm recently announced an aerosol pressure can for Kroil, its solvent for dissolving gum, rust, and corrosion.

No. 25 Actual Size
Pitch 1/4" Width 1/8"

No. 35 Actual Size
Pitch 3/8" Width 3/16"

No. 41 Actual Size
Pitch 1/2" Width 1/4"

No. 40 Actual Size
Pitch 1/2" Width 5/16"

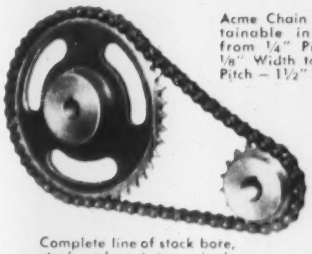
No. 50 Actual Size Pitch 5/8" Width 3/8"

USE ACME CHAIN FOR EVERY POWER TRANSMISSION REQUIREMENT:

driving·conveying·timing

Acme Chains are efficient, economical and positive for power transmission. They are readily adaptable to any drive when maximum efficiency is essential. Correct principles of design provide operating characteristics superior to any other method of power transmission. Replacement parts always readily available from stock.

Your inquiry will place a skilled Acme engineer at work on your power transmission problems.

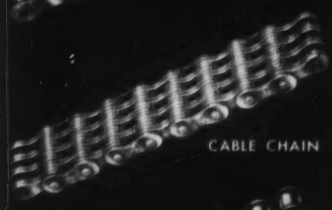

Acme Chain is obtainable in sizes from 1/4" Pitch – 1/8" Width to 2 1/2" Pitch – 1 1/2" Width.

Complete line of stock bore, steel and cast iron single sprockets, cast iron hub sprockets and all steel split or solid hub sprockets available.

FREE CATALOG

Write Dept. 11-N for your 80 page copy of Acme's latest catalog. Packed with valuable data.

CONVEYOR CHAIN
STANDARD and OVERSIZE ROLLERS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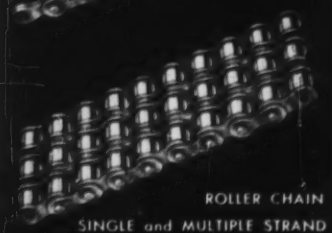
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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Tubes, Cylinders

Carborundum Co., Refractories Div., Perth Amboy, N. Y., has issued its eight-page magazine, Refractories, featuring tubes and cylinders.

Data is given on the properties of the firm's refractories, along with cross sections of some of the tubes and cylinders designed and made by the company.

Speed Reduction Drive

Catalog SRD-57 illustrates and describes Shaft-King speed-reduction drives manufactured by American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.

The 16-page booklet contains service classifications, drive selection tables for single and double reduction units, installation tips and construction features.

Propane, Butane Meters

An eight-page bulletin, OG-412, issued by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. combines descriptions of liquid meters for measuring liquid propane, liquid butane and liquid propane-butane mixtures.

In addition to product descriptions and illustrations, the new bulletin features a two-page illustrated explanation of the firm's over-all dispensing system, designed to insure that the product remains in a liquid state throughout metering. Basic elements of LPG liquid metering systems are shown in proper position, and a drawing of a typical vapor manifold arrangement for an LPG system is included.

Miniature Bearings

A 24-page catalog outlining the type and functions of miniature precision ball bearings is available from Miniature Precision Bearings, Inc., Keene, N. H.

The catalog describes in detail standard radial miniature bearings which range in size from $^1/_{10}$ in. to $^3/_8$ in OD. Descriptive matter and bore dimension charts is included on all the radial types including radial retainer, flanged radial retainer, single and double shield radial retainer, single and double shield flanged radial retainer, radial, flanged radial, high speed, and flanged high speed.

Stationary Air Compressors

Three new pieces of literature describing the firm's line of Westinghouse unit type and Le Roi stationary air compressors have been issued. The compressors described in the literature range in size from $^1/_2$ to 100 hp and include both single and two-stage units.

Features described in the two-color folders are lubrication systems, automatic protections, and volumes and pressures. Some specifications are also listed. The literature may be obtained from Le Roi Div., Westinghouse Air Brake Co., Milwaukee, Wis.

Filtration Equipment

Croll-Reynolds Engineering Co., 17 John St., New York 38, N. Y. has issued a bulletin giving specifications on sizes and capacities of its filtration facilities.

Included is data on the firm's laboratory, pilot plant demonstrators, special engineering services and the methods of filtration used.

Stainless Fasteners

Allmetal Screw Products Company, Inc., 821 Stewart Ave., Garden City, N. Y., has published a 52-page stainless fastener stock list and data book.

The book includes illustrations, thread and design specifications, and availability in a variety of corrosion-resistant metals of forty basic fastening devices, engineering data relating to the composition, properties, applications and weights of stainless steels.

Cutter, Accessories

A cutter and accessories catalog has been published and is now available from Brown & Sharpe Mfg. Co., Providence, R. I.

The 96-page illustrated catalog, designated as No. 37C, covers the company's line of metal cutting tools, as well as arbors, adapters, collets, vises, index plates, work driving dogs, taper mandrels, expansion bushings, and spring chucks. Listed for the first time are over 200 entirely new items, including a new line of ball-end mills, both double-end and extended lengths, and an additional line of shell end mill arbors.

Sheet Packing

A four-page catalog section that describes the firm's line of sheet packing for handling liquids, gases, and abrasives has been published by B. F. Goodrich Industrial Products Co., Akron, Ohio.

The catalog section illustrates standard sheet packing, describes their uses, and explains in detail how to order. Two pages are devoted to data and specifications. Although generally considered for gasketing or sealing service, the sheeting may also be used for matting, padding, and bumper service, the firm says.

Flexible Tubing

Flexible tubing made from teflon is described in Bulletins 4 and 5 recently issued by Pennsylvania Fluorocarbon Co., 1115 N. 38th Street, Philadelphia 4, Pa.

The tubing offers complete chemical inertness, flexibility and toughness even at the temperature of liquid oxygen, widest service temperature of any plastic tubing, −268 to +275 C, lowest coefficient of friction of any solid material, excellent electrical properties and very low permeability, the bulletins state.

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KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Plastic Protectors

The firm's line of plastic plugs and caps for protecting internal and external threaded parts and ends of tubes is described and illustrated in an 18-page bulletin, No. P 5708, offered by S. S. White Plastics Div., 10 E. 40 St., New York 16.

More than 200 different plastic protectors are discussed in the bulletin, including those molded from rigid acetate, and from flexible vinylite. Major plug and cap designs for each of the two lines are described in individual sections, with key specifications given in table form. The bulletin is illustrated with 100 photographs and drawings of different types of caps and plugs.

Metal Sheet Handling

Dexter Folder Co., 219 E. 44th St., New York, offers a four-page illustrated bulletin covering its heavy-duty metal-sheet handling equipment for automatically feeding and delivery piling both ferrous and nonferrous sheets in sizes up to 120 × 180 in. Loads handled weigh up to 15 tons.

Specifications are given for hydraulic feeders, hi-lift feeder, and pile delivery for gathering and jogging delivered sheets into a square pile at the end of the production line. Technical information includes operating speeds, thicknesses of sheet or plate handled, load capacities and brief explanations of how the machines operate.

Miniature Inertia Switch

A miniature inertia switch, said to be the smallest yet known, that operates by a radically new, simple principle, has been announced by Safe Lighting, Inc., 527 Lexington Ave., New York 17.

It is designed to eliminate usual "stiction," causing unreliable function, complicated mechanisms, and waste space. One single moving part, frictionless in operation, momentarily closes electrical contacts, following impact or acceleration above a preset value.

Switch setting is adjustable from 1.5 G up, tolerance ± .15. Volume is $\frac{1}{2}$ cu in. and weight $\frac{3}{4}$ oz.

Water Evaporators

Badger Mfg. Co., 230 Bent St., Cambridge, Mass., has made available an eight-page brochure describing three types of water evaporators designed and manufactured by the company.

The publication illustrates and describes vapor compression apparatus as well as the more recently-developed flash evaporator and the Badger-Hickman centrifugal compression still. It lists models and capacities, giving approximate weight, space requirements and other pertinent data. Flow sheets diagrammatic material and photographs are included.

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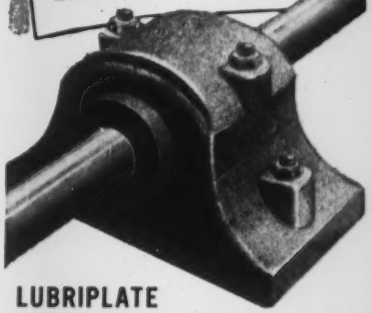

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are grease type lubricants especially formulated for use in bearings and on other machine parts subject to heavy loads. Have extremely high film strength, marked adhesiveness and water repellence.

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REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Write for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. LUBRIPLATE DIVISION, Fiske Brothers Refining Company, Newark 5, N. J. or Toledo 5, Ohio.

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Induction Heater

Features of high frequency motor-generator induction heating equipment applicable for low cost brazing, annealing, deep hardening, forging, and melting are covered in a new bulletin released by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Included in the bulletin, No. 12B8513, is a description of 960, 3000 and 10,000-cycle high-frequency motor-generator units available in sizes from 30 to 1250 kw.

Welding, Heating Blowpipe

Oxweld W-47, a new welding blowpipe said to be capable of welding any metal thickness from 28-gage sheet to 3-in. plate is described in a new eight-page booklet available from Linde Co., Div. Union Carbide Corp., 30 E. 42nd St., New York 17.

The firm says the blowpipe is able to handle gas flows as low as 2 cu ft per hr for precision welding, or total flows as high as 1500 cu ft per hr for heavy heating operations. Cutting attachments that convert the blowpipe from welding and heating to flame-cutting on thicknesses up to 8 in. are also described n the booklet, No. 1107.

Analog-To-Digital Converter

Systems Div., Beckman Instruments, Inc., 325 N. Muller Ave., Anaheim, Calif., has available a four-page brochure on its all transistor analog-to-digital converter.

This high speed ADC was originally developed for use in the firm's Model 112 data handling system. The brochure contains specifications and utilizes basic circuit diagrams and sketches to explain operation.

Heat Exchangers

Pfaudler Co., 1046 West Ave., Rochester, N. Y., has issued Bulletin no. 949 on the company's heat exchangers and condensers.

General uses and installation sketches of shell and tube equipment are illustrated, and listings for heat exchanger applications in the process industries are charted. These include FTS fixed tube sheet, PFH packed floating heat, IFH internal floating head, and the UB-U hairpin tube. A section is devoted to design and construction features of this equipment with proper nozzle locations sketched and construction materials for varying operating conditions recommended.

Open Steel Flooring

A 16-page catalog on Weldforged open steel grating and stair treads is available from Kerrigan Iron Works, Inc., 11th and Herman St., Nashville, Tenn.

It contains a table of safe loads, engineering data on various size grating panels, fasteners and stair treads. Illustrations show various spacings between bearing and cross bars, installations around the nation and how gratings are fabricated for perfect fit around pipes, columns.

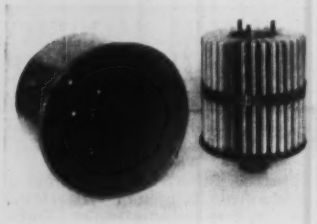
Sheet Packings

An eight-page illustrated bulletin giving specifications, engineering, application and testing data on a complete line of industrial sheet packings is available from Crane Packing Co., Dept. MXN, 6400 Oakton St., Morton Grove, Ill.

The nineteen varieties of packings covered are fabricated from such materials as asbestos, rubber, synthetic rubber, neoprene, silicone, fiber and teflon. All can be supplied in die-cut gasket form in any shape or size, standard or special.

NEW DRY TYPE AIR FILTERS

for engines, compressors, blowers and other industrial applications



• Designed for specific applications, the new Air-Maze Dry Type filter is particularly suitable where 1.) oil free air is required, 2.) an extremely high degree of filtration is required, 3.) the air velocity varies from one period to another and, 4.) the dirt concentration is relatively low, except when vibration is present to help dirt removal.

The Air-Maze Dry Filter is one of the most efficient mechanical type filters available. Laboratory tests indicate better than 98% efficiency with particles of 2 micron mean diameter and practically 100% efficiency with particles of 5 microns or larger.

The Air-Maze Dry Filter type DA employs a special highgrade felt filtering media arranged in deep pleats to provide extended area, and armored on both sides by heavy galvanized cloth. Heavy gauge perforated tubing inside the media and a metal strap on the outside form a rigid unit of great strength and are corrosion protected. Made in sizes from 20 cfm to 6650 cfm. Catalog DA-1056 available. Write **AIR-MAZE CORPORATION**, Cleveland 28, Ohio.

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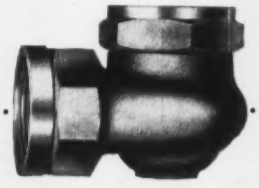

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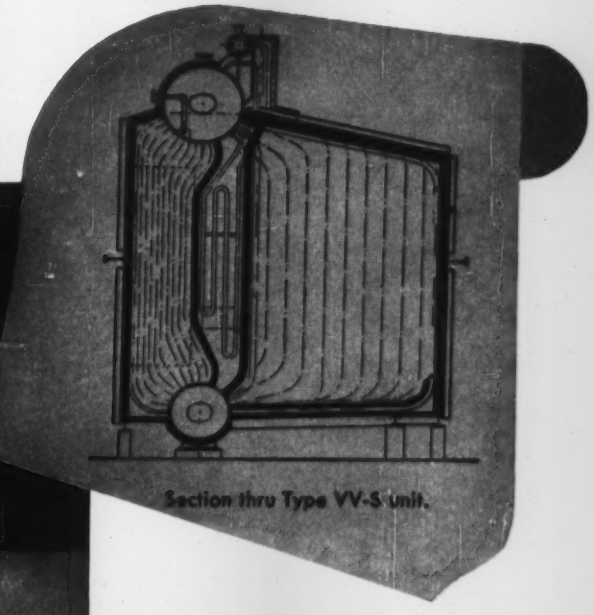
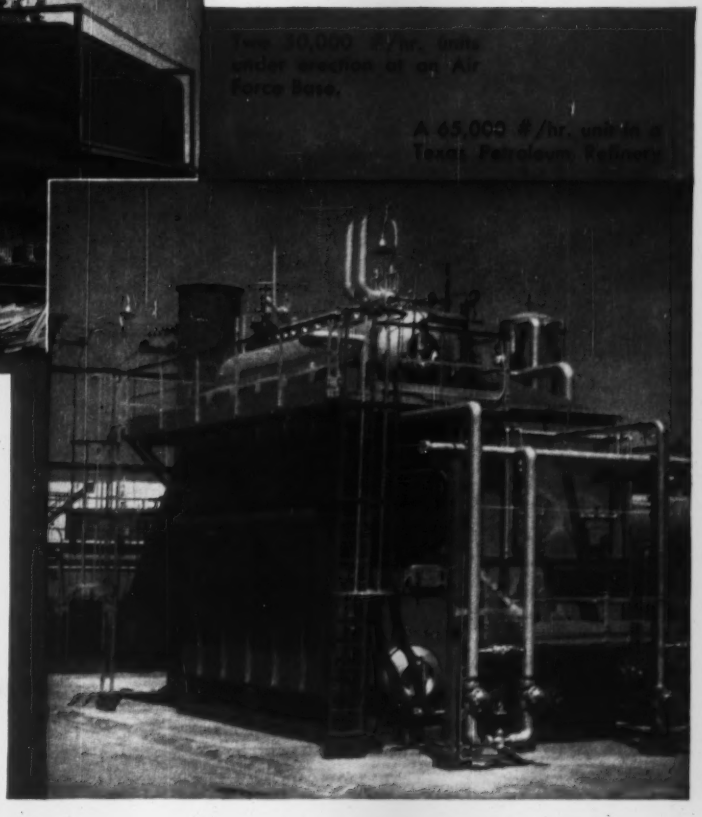
Vogt TYPE VV-S STEAM GENERATORS



Section thru Type VV-S unit.



- ★ Headerless construction for full unrestricted water circulation.
- ★ Large water storage capacity and correspondingly greater steam relieving space.
- ★ Long, narrow furnace ideal for oil or gas fuel.
- ★ Completely steel encased for "out-in-the-open" operation.
- ★ Simple slab foundation.
- ★ Capacities from 50,000 pounds to 100,000 pounds steam per hour.

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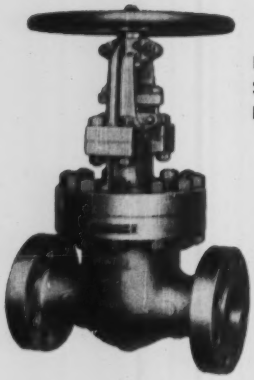


FIG. 1303 SS—1500-Pound Stainless Steel Gate Valve for handling Boiler Feed Water Treating Compound.

FIG. 3061 WE—300-Pound Steel Swing Check Valve.

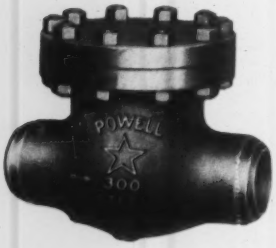


FIG. 16003 WE—600-Pound Steel Pressure Seal Gate Valve.

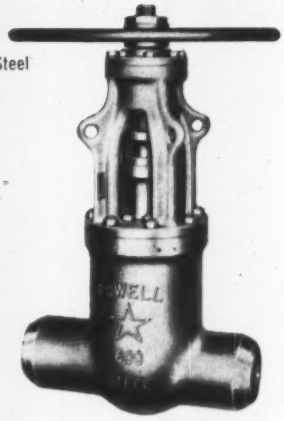
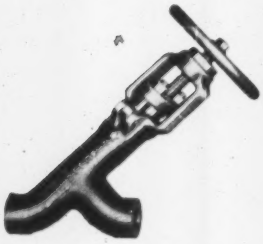


FIG. 1314 A—1500-Pound Integral Bonnet Steel "Y" Valve.



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KELLOGG'S ERECTION TECHNIQUES KEEP PACE

K-WELD* is one of M. W. Kellogg's many advanced shop fabrication techniques which have been adapted by the company's construction department for field erection of critical power piping. A patented inert gas-shielded method of arc welding which eliminates backing rings and oxidation, K-Weld provides in field erection a smooth internal wall contour equal to that obtained under controlled shop conditions. For "average" as well as super-critical operating conditions, wherever the ultimate in welding is required, more and more power generating companies are turning to K-Weld.

A typical example is found currently in a 137,500 KW unit for a large eastern utility plant. Here, Kellogg is erecting the critical piping for the latest unit. Reheat piping, being K-Welded above, is 2¼% chrome-1% molybdenum alloy, 24.8750" OD, 1.1875" wall thickness. Main steam line is 10.906" ID, 2.410" minimum wall thickness, and 7.906" ID, 1.792" minimum wall thickness, and will operate at 1,940 psi, 1,000 F throttle temperature. For maximum performance, K-Weld is being used on both the main steam line and hot reheat line.

M. W. Kellogg welcomes inquiries on its complete service to the power piping industry from consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.

Kellogg keeps pace in theory as well as practice. This 400 page book is the most comprehensive work ever made available publicly on the design of power piping. This volume, now in its 2nd Edition, is published by John Wiley & Sons, Inc., New York.

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(CARBON-GRAPHITE)

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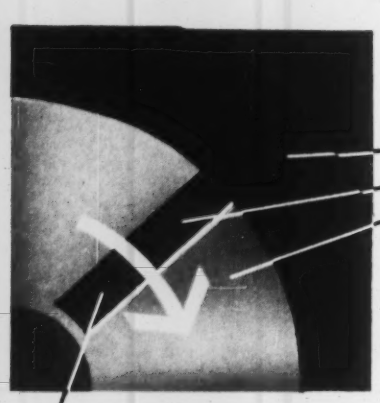
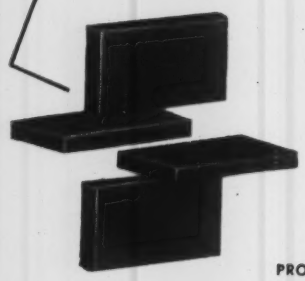
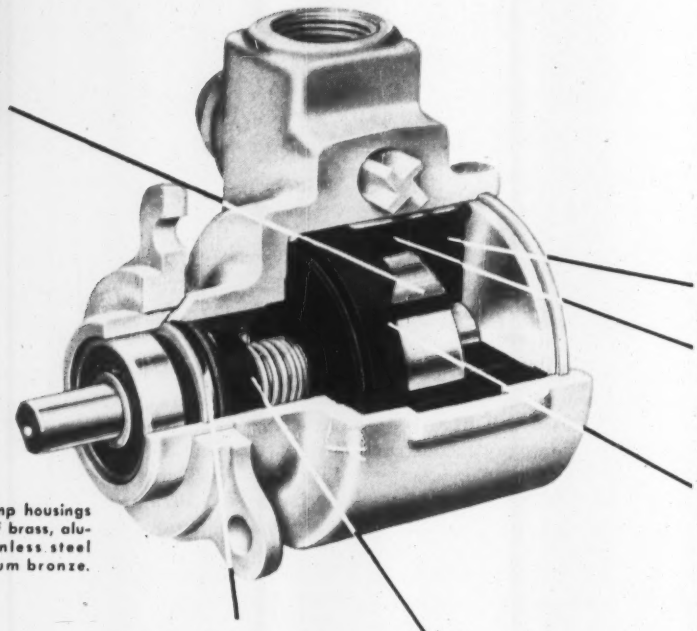
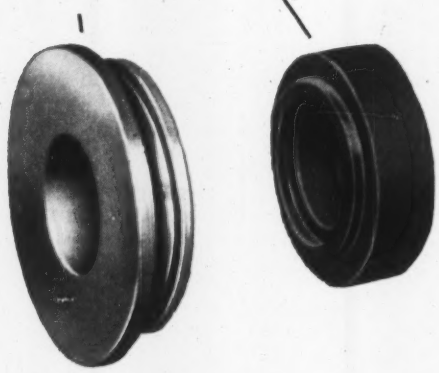






PROCON pump housings are forged of brass, aluminum, stainless steel and aluminum bronze.

GRAMIX seal-ring retainer



GRAPHITAR is ideal for high-stress parts . . . pistons, cylinder liners, bearings and seals . . . because it's so resistant to temperature change and wear. Chemicals, concentrated acids, highly corrosive ammonia have little effect on GRAPHITAR . . . in fact, may even serve as lubricants to GRAPHITAR parts. GRAPHITAR is lightweight, can be produced economically in most any size and shape, and held to tolerances as close as .005". Perhaps self-lubricating GRAPHITAR parts can improve the efficiency of your products. For more information on GRAPHITAR and its many applications, write for Engineering Bulletins No. 20 and 21.

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GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES

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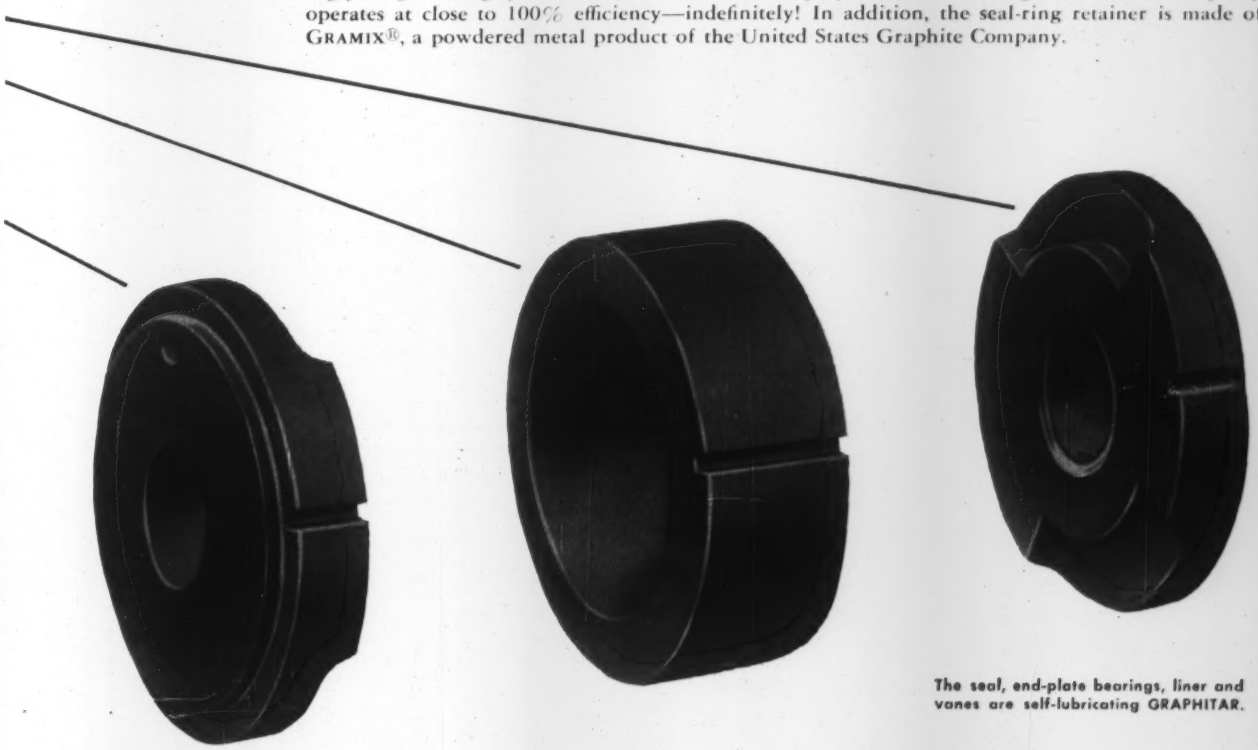
gives PROCON PUMPS amazing performance in handling *ALL TYPES OF FLUIDS*

10¢ dropped in a beverage machine in Minneapolis actuates a pump that fills a paper cup with syrup and carbonated water; a Utah dentist flicks a switch that starts a vacuum pump used in molding dentures; in a manual training school in North Carolina, a pump circulates the ammonia in a blueprint machine.

Mixing soft drinks . . . pumping chemicals, ethyglycol, ammonia . . . even pumping hot fats at the rate of 275 gallons an hour at pressures up to 300 psi, is the every-day work of the dependable little Procon pump, manufactured by the Procon Pump and Engineering Company of Detroit, Michigan. The liner, vanes, end-plate bearings and the seal ring of this versatile, high performance pump are made of GRAPHITAR. The four GRAPHITAR rotor-vanes run directly against a GRAPHITAR liner. By running GRAPHITAR against GRAPHITAR the self-lapping, self-lubricating and astonishingly long-wearing qualities of GRAPHITAR are employed to full advantage . . . the Procon pump operates at close to 100% efficiency—indefinitely! In addition, the seal-ring retainer is made of GRAMIX®, a powdered metal product of the United States Graphite Company.



The seal, end-plate bearings, liner and vanes are self-lubricating GRAPHITAR.

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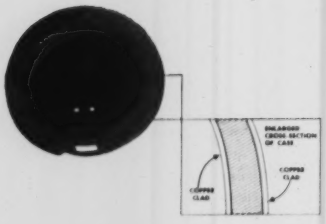

Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece*. The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corporation* **Dept. 29, Skokie, Ill.**

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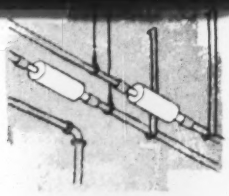
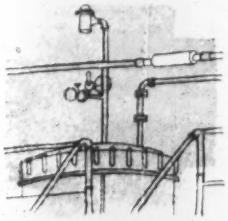
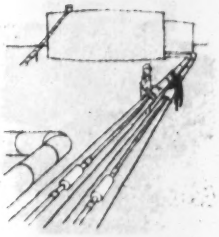


HEATING SYSTEMS

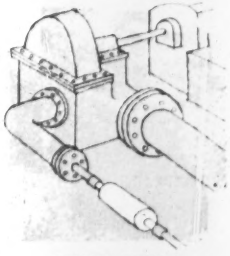


PROCESS PIPING

NOW . . . high-pressure, heavy-duty Expansion Compensator costs far less than old-fashioned methods... *available from stock!*



STEAM TRACING



POWER PIPING

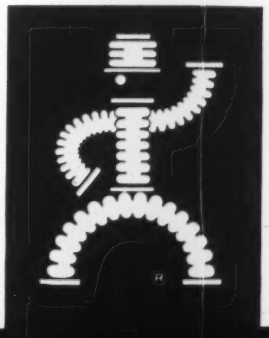
Flexon®

MODEL H EXPANSION COMPENSATOR

Get delivery when you want it! Flexon Model H Expansion Compensators are available from stock. And they cost much less per inch of stroke than any other method of absorbing pipe expansion.

Flexon Model H is made to fit the thousands of industrial piping jobs that use pipe up to 3" and require less than 1¼" total movement. It's built for hard service, with 2-ply stainless steel Flexon Bellows, positive anti-torque and anti-squirm device, and full protection from external damage. Completely packless, it never needs maintenance. Working pressures up to 150 p.s.i. for ¼" and 1" sizes; up to 100 p.s.i. for larger sizes.

Write for facts about Flexon Expansion Compensator, design and cost data, and the name of your Flexon distributor.



Flexonics corporation

EXPANSION JOINT DIVISION • 1305 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EXPANSION JOINTS

METAL HOSE

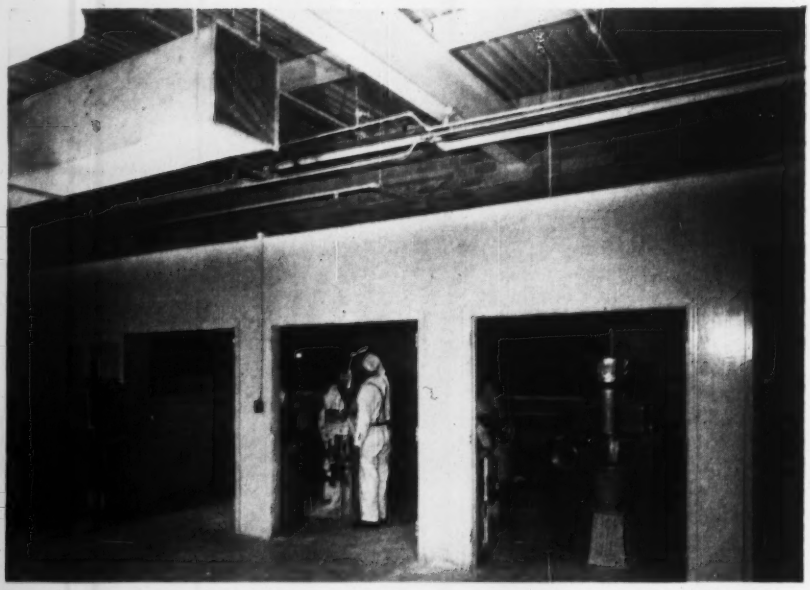
NON-METALLIC HOSE

BELLOWS

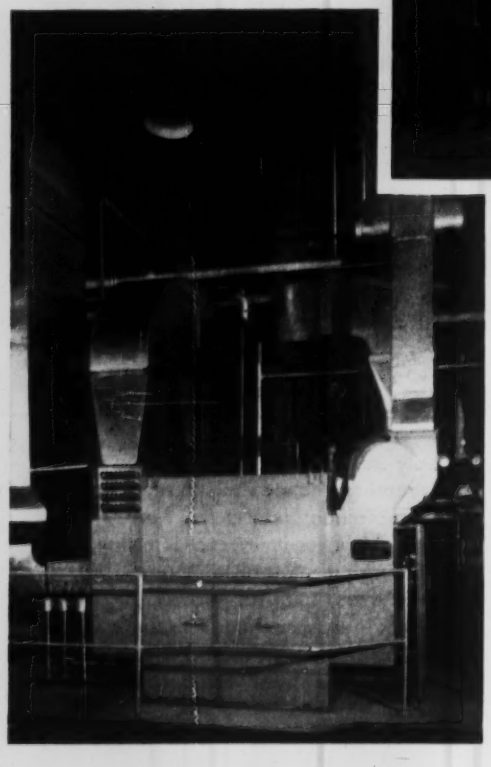
AIRCRAFT COMPONENTS

NO HEADACHES

from unwanted moisture



This Lectrodryer makes this 15,680 cubic foot room independent of outside weather conditions.



Whitehall, makers of ANACIN, dehumidify with **Lectrodryer***

Tableting at Whitehall Pharmacal Company, Elkhart, Indiana, is done in a DRY atmosphere. A Type CHO Lectrodryer holds this room at 20% relative humidity at 70°.

No moisture to contaminate fine products or slow their flow.

Your moisture problems may be solved equally easily with Lectrodryers. The book *Because Moisture Isn't Pink* tells how others are safeguarding products and production by eliminating unwanted moisture. For a copy, write Pittsburgh Lectrodryer Divison, McGraw-Edison Company, 335 32nd Street, Pittsburgh 30, Pa.

Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF.

Industry gets tons of oxygen ...*with no capital investment*

MANY steelmakers and chemical processors who use oxygen or nitrogen obtain these gases from on-site facilities built, operated, and maintained by LINDE. Operating efficiently and safely for more than ten years, these installations prove that industrial users can economically obtain tonnage quantities of atmospheric gases from LINDE on-site plants. No capital investment is required from the user, and the price for oxygen is guaranteed by LINDE. The savings resulting from such planning are quickly apparent.

The extreme cold developed in LINDE on-site plants—lower than 300 degrees below zero F.—is an additional "raw material" for low-temperature processing. And, every LINDE customer shares the benefits of LINDE's research, development, and service in the industrial gas field.

Whether your application is of bench scale, for a pilot plant, or for high-volume production, you can save by utilizing the flexible facilities of LINDE. You can obtain LINDE gases in liquid or gaseous form... by tank car or tank truck... in manifolded cylinders or in a single cylinder... or from an on-site plant.

For more than 50 years, LINDE has been supplying oxygen and other gases when, where, and in the amounts wanted. For further information, write Dept ME-12, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

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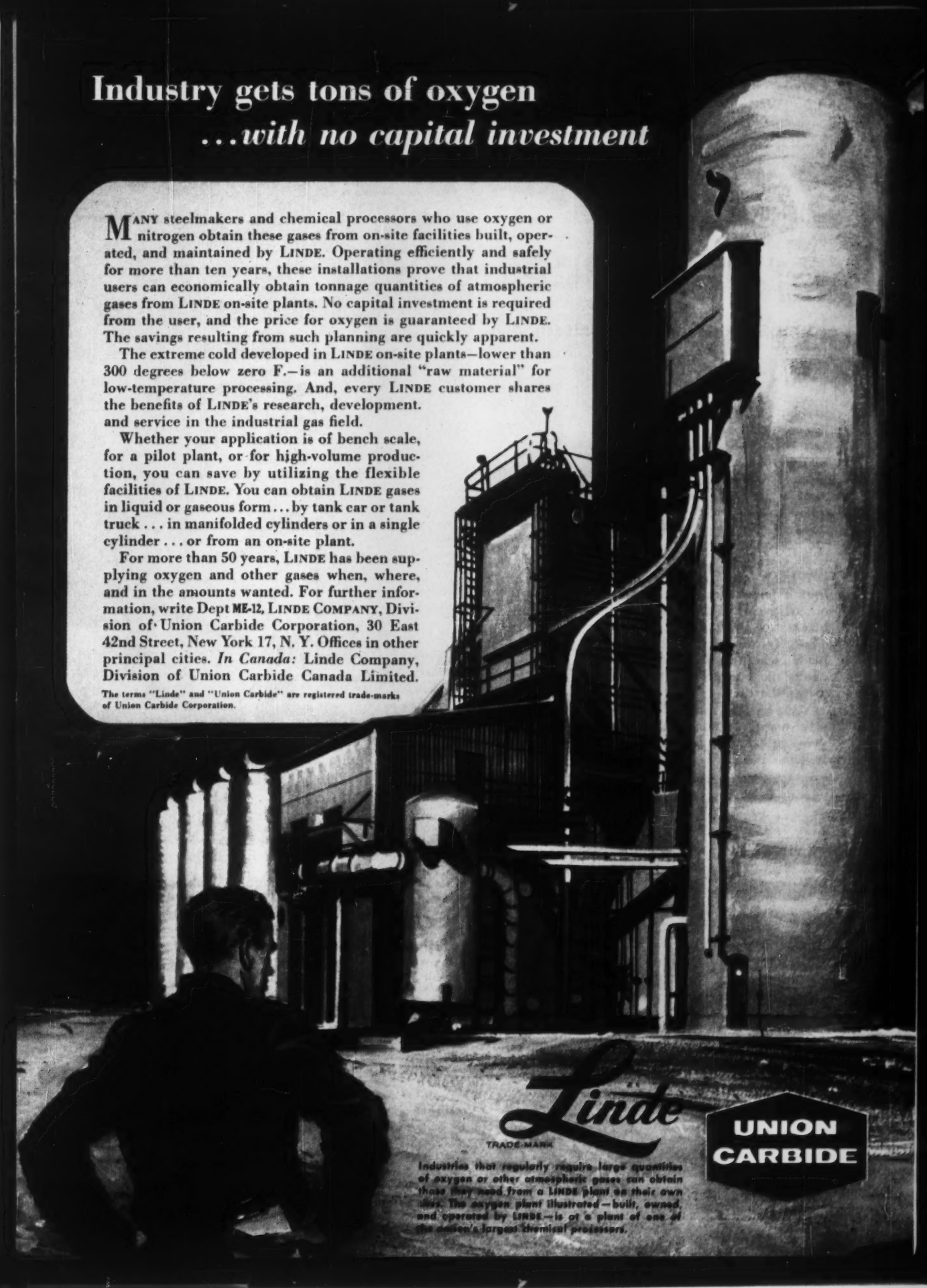


Linde
TRADE-MARK

UNION CARBIDE

Industries that regularly require large quantities of oxygen or other atmospheric gases can obtain those they need from a LINDE plant on their own sites. The oxygen plant illustrated—built, owned, and operated by LINDE—is of a plant of one of the nation's largest chemical processors.

SOLID WHEEL

spells non-stop turbine performance

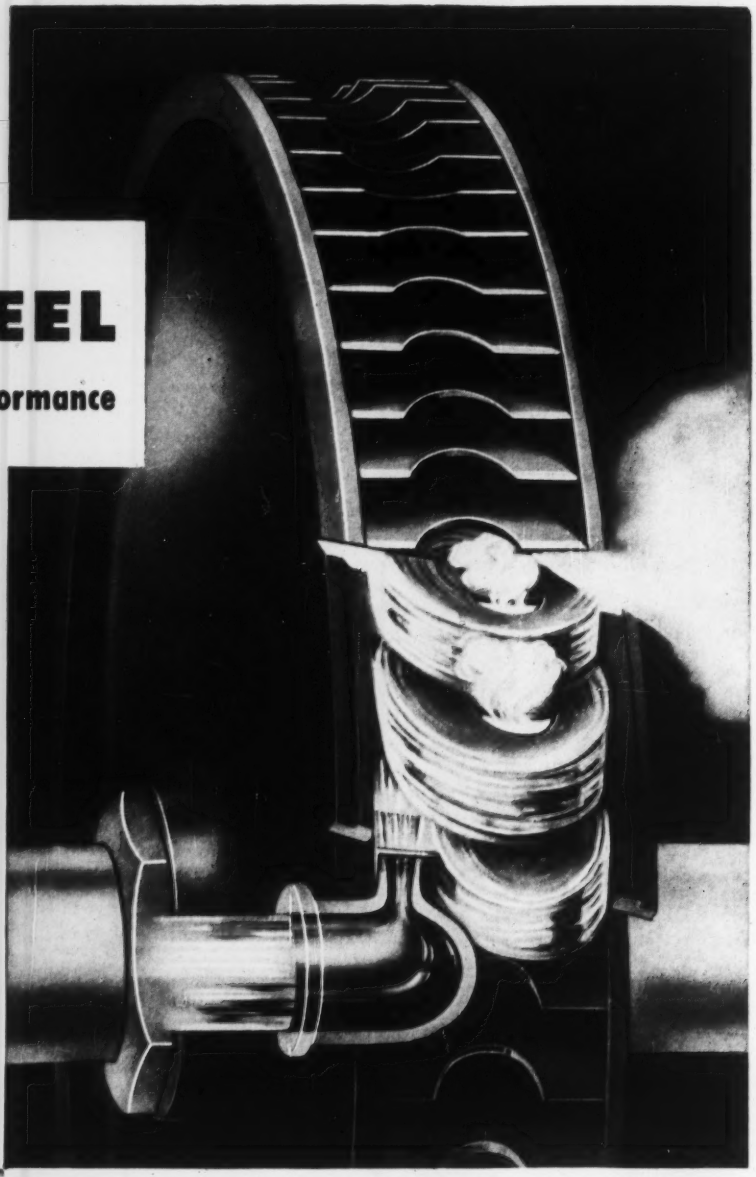
It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

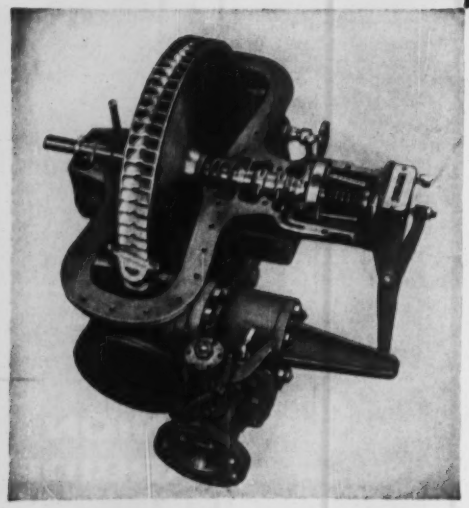
The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.





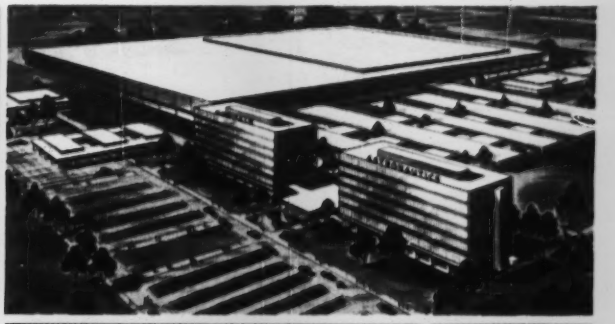
Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

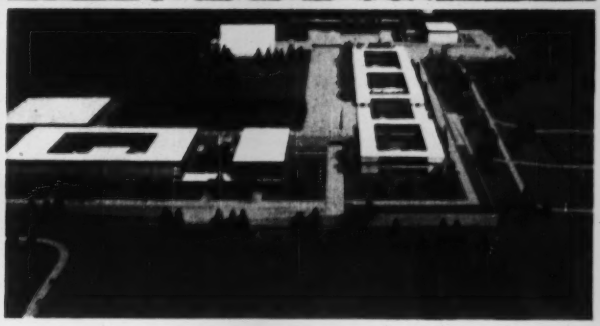
TERRY

THE CROSS COMPANY—Fraser, Michigan
This automation equipment producer's new plant has two 12-million btu C-E Hot Water Boilers.

CONVAIR-ASTRONAUTICS—San Diego, California
New Convair space-flight research center will have two 30-million btu C-E Hot Water Boilers.



RIVERVIEW COMMUNITY HIGH SCHOOL—Riverview, Mich.
Two 10-million btu C-E Hot Water Boilers heat Riverview's recently expanded high school.



U.S. AIR FORCE ACADEMY—Colorado Springs, Colorado
Choice of five C-E units here typifies widespread Air Force acceptance of high temperature hot water.

HIGH TEMPERATURE WATER

today's new idea in large space heating

In such diverse applications as industrials, large educational institutions, and military bases, high temperature water is finding rapidly increasing acceptance as an ideal means of heating large areas.

A big factor in bringing this trend about is The C-E La Mont Controlled Circulation Hot Water Boiler. Using the same principle as that applied by C-E in many of the country's largest utility boilers, this new boiler provides a degree of temperature control that makes it the most attractive method of heating in many cases. With a wide range of capacities—from 10 to 300 million Btu's—these boilers operate at water pressures up to 500 psi and temperatures to 470F, or higher. A C-E Hot Water Boiler can save from 10 to 20 per cent in maintenance and operating costs.

Combustion Hot Water Boilers in the smaller capacity range are completely assembled in the shop while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

So, if you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate the use of high temperature water as your heat source. Because individual needs vary, both steam and hot water have their place. Our engineers will be pleased to discuss either method with you or your consultants—impartially and with no obligation.

For further details on high temperature water boilers by C-E write for our catalog HCC-2.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N.Y.
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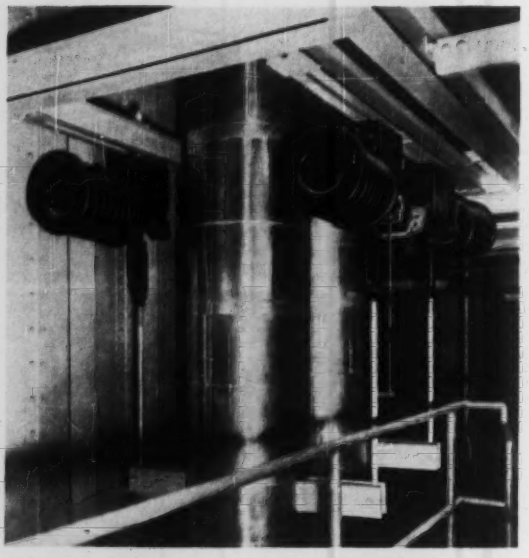
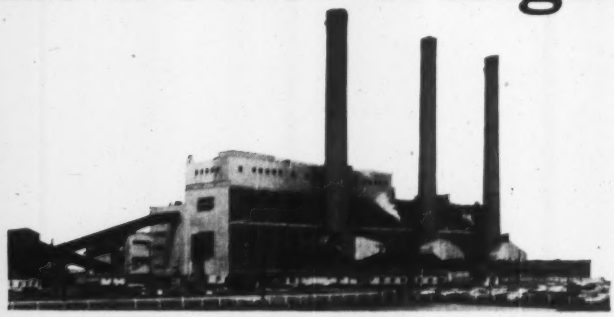
C-120A

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For Indianapolis Power & Light



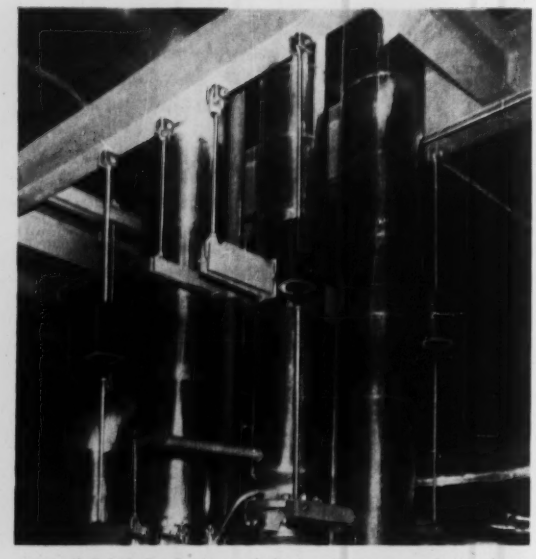
Grinnell Model R Constant-Support Hangers on cold reheat riser piping. Constancy of support which hangers provide is mathematically perfect for all positions of travel. Note low headroom requirement. Hangers available in sizes for loads ranging from 30 lbs. to 32,260 lbs., with travels up to 12 inches.



H. T. Pritchard Generating Station, Indianapolis Power & Light Company

Pipe Hangers by Grinnell

Six generator units have been built at H. T. Pritchard Station of Indianapolis Power and Light Company since 1947, adding up to a total station capacity of 376,000 kw. In each unit built at this station, just as in every new station constructed by this company, Grinnell Pipe Hangers and Supports have been used exclusively.*



Grinnell B-268 Pre-Engineered Spring Hangers on boiler feed piping. Patented precompression feature assures operation of spring within its proper working range. Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. Available in 21 sizes for loads ranging from 50 lbs. to 28,200 lbs.

There's good reason why major power companies like Indianapolis Power & Light look to "America's #1 Supplier of Pipe Hangers and Supports." A volume producer of pipe hangers, Grinnell backs up this advantage with an efficient coast-to-coast distribution system of warehouses and jobbers. You can depend on Grinnell for quick deliveries. In fact, even complex hanger requirements often can be met with hanger assemblies right off the shelf. This not only saves you time — but it can save you money, by cutting down on the number of special items which must be manufactured.

Benefit from expert knowledge gained during more than a century of piping experience. On your next piping job, specify Grinnell.

*Work done in collaboration with Gibbs & Hill, Inc., N.Y.C.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

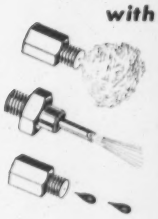
"CLICK" lubrication starts when your machines start!

ALEMITE OIL-MIST AUTOMATIC LUBRICATION

provides constant, uniform, foolproof lubrication— at savings up to 90%!

Alemite Oil-Mist *atomizes* oil into tiny, airborne particles that are distributed to bearings through tubing. It bathes all bearings with a cool film of clean oil . . . maintains uniform oil film regardless of variations in loads, temperature and speed. Simple, continuous, fully automatic. Eliminates the waste and uncertainties of the "human element" in lubrication. Uses up to *90% less lubricant* than ordinary lubrication methods!

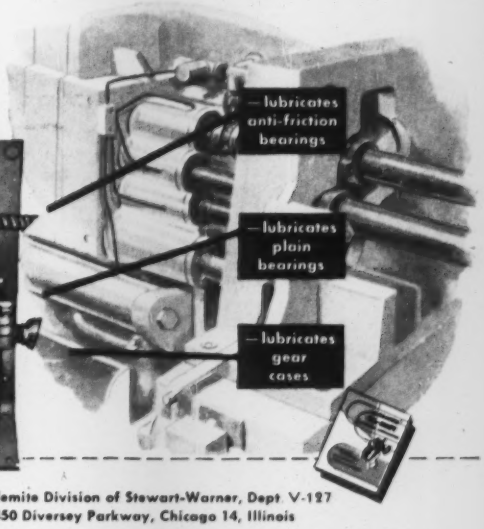
Lubricates any bearing on any machine with one of three types of fittings:



Mist fittings for roller, ball, needle—or any anti-friction type of bearings.

Spray fittings for open and enclosed gears and chains.

Condensing fittings for plain bearings, slides, ways, vees, cams, and rollers.



8 Advantages of the Alemite Oil-Mist System

1. Continuous lubrication. Deposits fresh, clean film of oil on all surfaces of all bearings.

2. Fully automatic. Starts and stops with operation of machine switch.

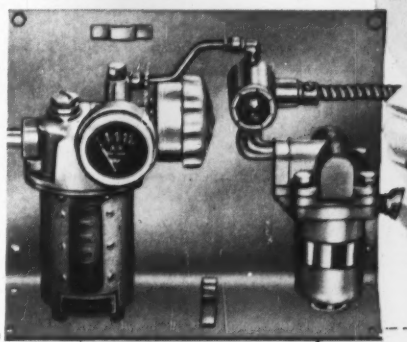
3. No guesswork. Bearings can't be overlooked, or over-lubricated!

4. Reduction of bearing temperatures. Acts as bearing coolant. Reduces bearing temperatures as much as 20°F.

5. Fewer types of oil. Reduces number of oils that must be stocked, handled and applied.

6. Elimination of downtime. All bearings are constantly lubricated while machines continue to operate.

7. Extension of bearing life. Life of grinding machine bearings have been extended from 400 to 7,000 hours!



8. As high as 90% less oil consumption. Usually consumes about 1/10th amount used by any other oiling method.

Mail coupon for Oil-Mist demonstration and information

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Division of STEWART-WARNER CORPORATION

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Alemite Division of Stewart-Warner, Dept. V-127
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☐ Please send me a FREE copy of your new and complete Oil-Mist catalog.

☐ Please have your Alemite Lubrication Representative arrange a no-obligation demonstration.

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PLUS CASH AWARDS IN 1958

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$150 cash prize and trip to New York for the best paper on the subject of "Student Development of Professional Engineering Attitudes and Ethics."

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$150 cash award and trips to Detroit and New York

3 UNDERGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an Engineering subject.

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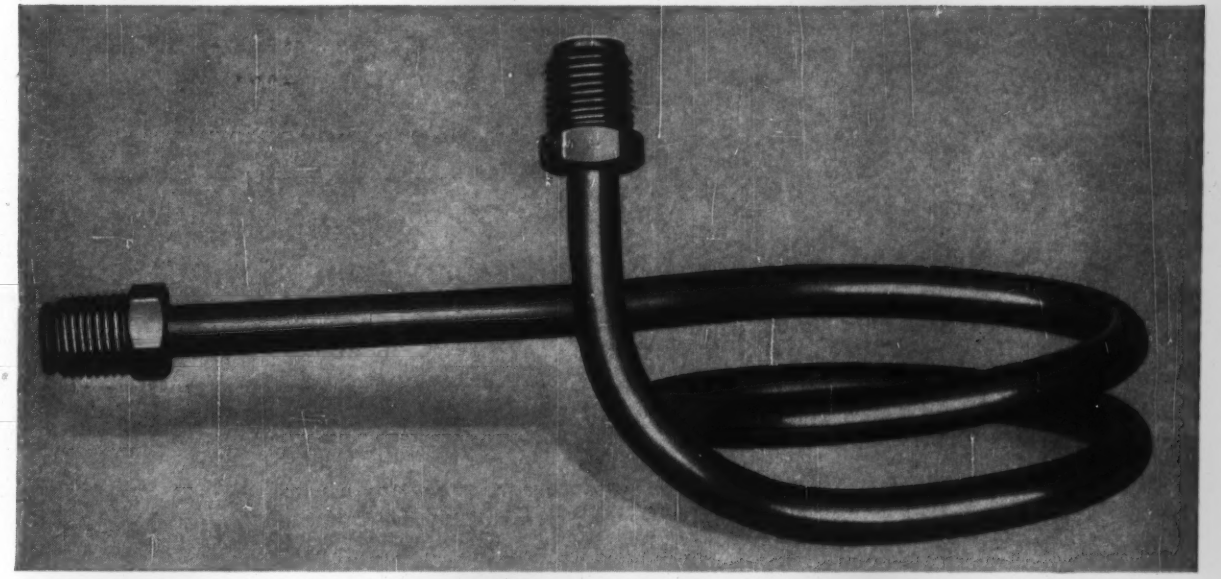
$25 cash prize plus trip to New York for best paper on an engineering subject

for rules covering eligibility, preparation and closing dates for these awards

CONSULT YOUR FACULTY ADVISER NOW!

Space limits, low tolerances on brake tube call for Bundyweld's greater ductility



Double loop in this junction tube lets it meet rigid space requirements; also absorbs vibrations set up by differences in the movements of power cylinder and junction block. Tight tolerances are held on both the loop and the position of the ends, which are double-flared with fittings attached.

PROBLEM: Produce a junction tube to fit the restricted space between the power cylinder and junction block in a power-brake system . . . yet hold the low tolerances required for high-speed assembly.

SOLUTION: Take advantage of Bundyweld's greater ductility to design a *dual-purpose* junction tube — as Bundy® engineers helped one customer do. Not only does the tube meet limited-space and low-tolerance requirements . . . but its specially designed loop absorbs vibrations set up by differences in the movements of power cylinder and junction block.

Here again, Bundyweld® was chosen because its greater ductility permits holding tricky tolerances in mass production. And Bundyweld's high bursting strength assures long-lived *leakproof* performance in any high-pressure hydraulic system . . . one reason it has become the safety standard of the automotive industry. *95% of today's cars use Bundyweld, in an average of 20 applications each.*

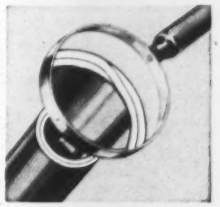
Bundy's skilled fabricators mass-produce the junction tube—coil the tubing, attach the fittings and then double-flare the tubing ends. Finished parts are delivered on schedule . . . clean and ready to use.

If *you* want to save time, hold down costs on tubing design or fabrication, check first with Bundy. Call, write, or wire us today.

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld, double-walled and brazed through 360° of wall contact.

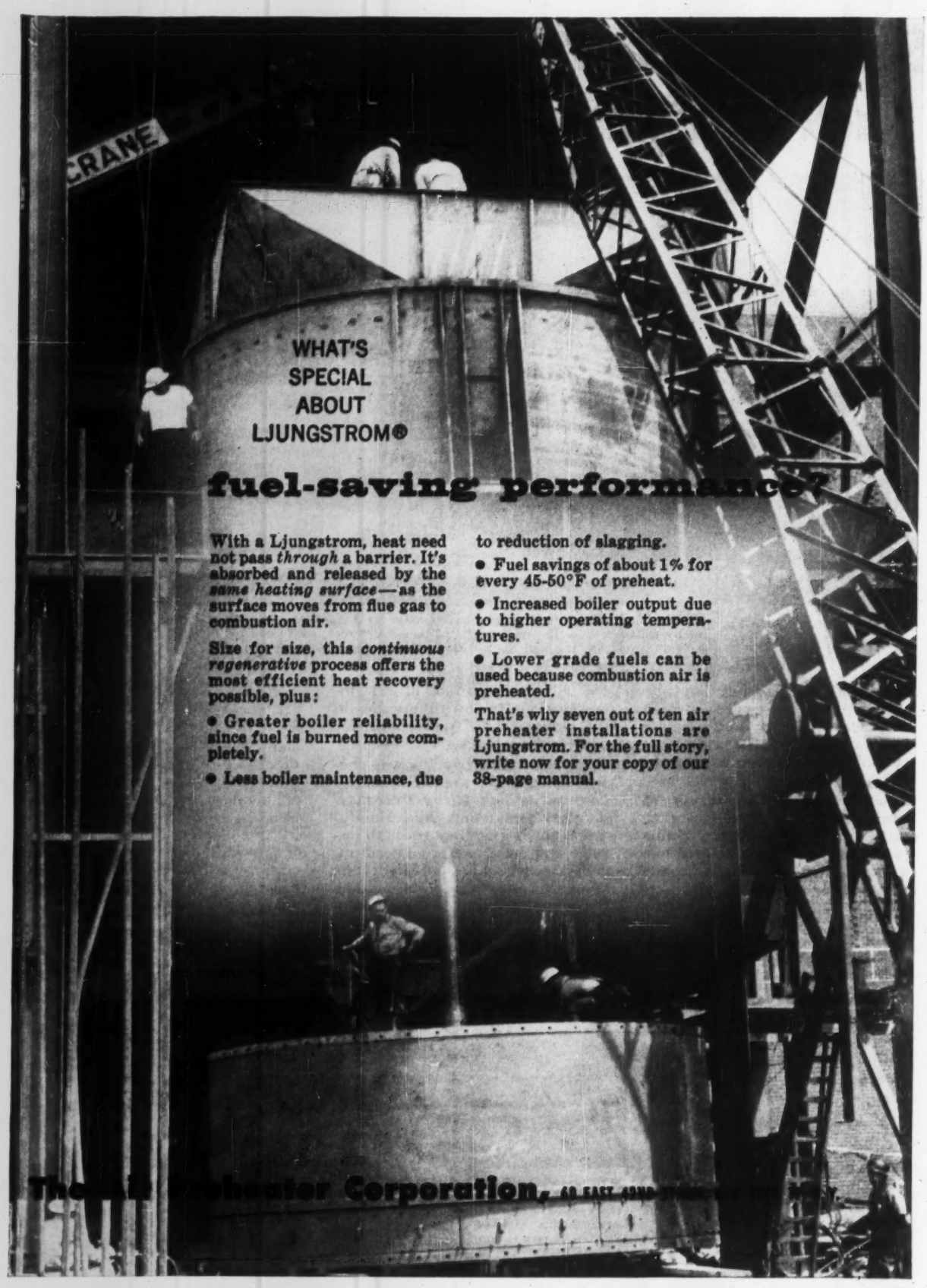


NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

THERE IS NO REAL SUBSTITUTE FOR

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP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LJUNGSTROM®
fuel-saving performance?
With a Ljungstrom, heat need not pass *through* a barrier. It's absorbed and released by the *same heating surface*—as the surface moves from flue gas to combustion air.
Size for size, this *continuous regenerative* process offers the most efficient heat recovery possible, plus:
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That's why seven out of ten air preheater installations are Ljungstrom. For the full story, write now for your copy of our 38-page manual.
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Engineers: Act NOW to move your career years ahead, with the company building the power plants for

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Even as you read this, ROCKETDYNE is testing the mighty propulsion systems to launch the major missiles of the Free World. There's a unique excitement in the work. It marks a turning point in history. Man is beginning to conquer space.

POWER—AND STILL MORE POWER

At ROCKETDYNE's 1600-acre Propulsion Field Lab. near Los Angeles, and in the new test stands at the Neosho plant in Missouri, the thrust ratings make previous engine development look puny by comparison. And still the demand is for even more power—power that gulps hundredweights of fuel per second—power that must be controlled with the delicate accuracy of a high precision instrument.

NEW WORLD OF ENGINEERING

This is a major new industry. The men who run it are professionals of an entirely new breed. Among them are mechanical and chemical engineers, physicists, dynamics specialists, creators of control systems of all kinds, heat exchange experts, research men, test engineers capable of handling the mightiest engines ever built. Every day two miles of data tape come from the test stands to teach them something new. If the state of their art could be put into print right now, the book would be out of date in a week.

At ROCKETDYNE you'll work with methods and techniques years ahead of conventional industry. You'll be a fully informed partner in major projects. Your advancement will be limited only by your own ability, and our educational refund plan can step up your qualifications for positions right at the top.

YOUR CAREER CAN GROW FAST IN THIS FAST-GROWING FIELD

NORMAN C. REUEL received his BS in Chem. E. at Georgia Tech. and an MSAE at Cal. Tech. specializing in jet propulsion. Following rocket and radar development in the Navy he joined North American Aviation in 1946 as a research engineer. Now assistant chief of design and development, he also finds time to relax at his ranch home, bowl, golf, and play tournament bridge.

PAUL D. CASTENHOLZ, Pacific combat veteran, graduated B.Sc. (Eng.), UCLA 1949. From research engineer his grasp of rocket engine work raised him through a supervisory post in experimental development to assistant group leader in combustion devices, and then to group leader of experimental engines. Recently completed requirements for his MSc. Relaxes with hi fi, fishing and back packing.

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MAIL THIS COUPON – FIRST STEP IN YOUR ROCKET ENGINE CAREER

Mr. A. W. Jamieson, ROCKETDYNE Engineer Personnel Dept. ME-12.
6633 Canoga Avenue, Canoga Park, California

Dear Mr. Jamieson: Please send me your brochure on careers at ROCKETDYNE. I am interested in the following fields (check one or more):

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Computer Analysis ☐ Research ☐

Name _____ Home Address _____

Degree(s) _____ Home Phone _____

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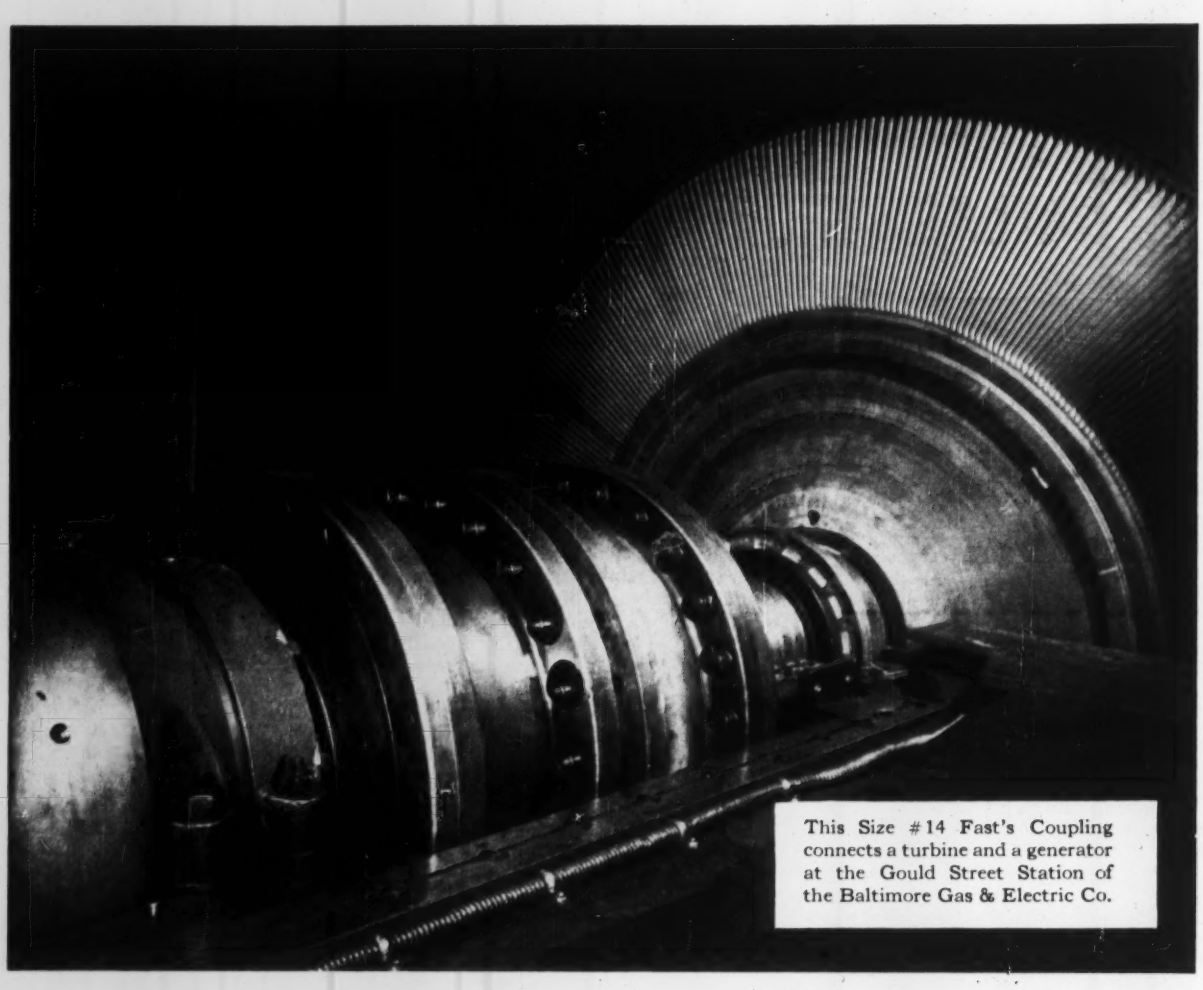


This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3412 Scott Street, Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Baltimore 3, Maryland

Engineered **Products**

Sold With *Service*

KOPPERS

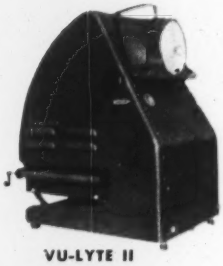
THE ORIGINAL

FAST'S Couplings

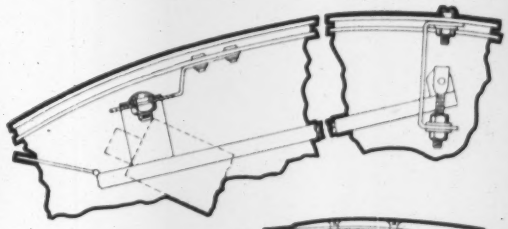
Waldes Truarc Rings cut assembly costs, improve performance of precision photo-optics equipment

Charles Beseler Co., E. Orange, N. J. uses Waldes Truarc Retaining Rings in 3 applications shown.

REFLECTING MIRROR ASSEMBLY IN OPAQUE PROJECTOR

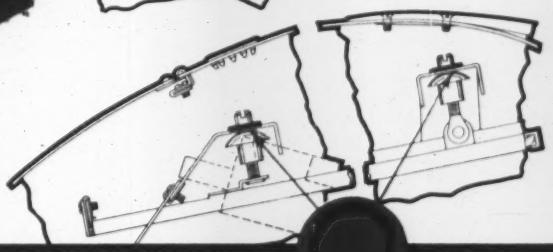


VU-LYTE II PROJECTOR



BEFORE

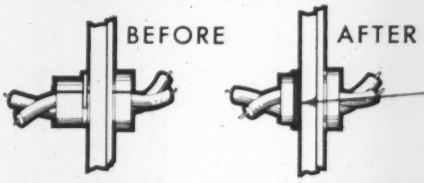
"The front surface mirror is the most precise optical element in a properly functioning opaque projector," Beseler writes. "Previously we used this extremely cumbersome means of holding the mirror in position. As mirror adjustments are always required and the mirror is extremely delicate, our spoilage was terrific."



AFTER

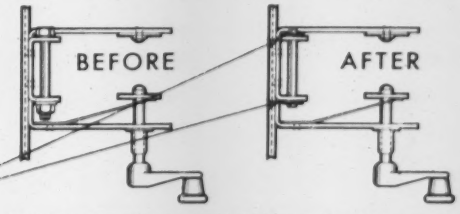
"Two Truarc Series 5100 Rings made possible complete redesign of the mirror assembly. Now mirrors can be adjusted from *outside* the projector. Rejects now are practically nil. More precise adjustment of the mirror is possible. And because of the greater ease in adjustment, we have cut labor costs $2.00 per unit."

HEAT ASSEMBLY IN PRINT DRIER



Here a Waldes Truarc crescent ring, Series 5103, replaced a split collar and clamping ring. Results: labor costs cut 50¢ per unit because of greater ease of assembly. Drier provides more uniform heating.

35 MM MICRO-FILM NEGATIVE CARRIER IN ENLARGER



2 Waldes Truarc Series 5133 E-Rings replaced 2 cap nuts—at a saving of 20¢ per unit in labor costs.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

WALDES

TRUARC®

RETAINING RINGS

WALDES KOHINOOR, INC.
47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications. *(Please print)*

Name _____

Title _____

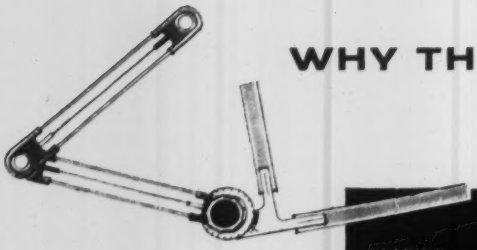
Company _____

Business Address _____

City _____ *Zone* _____ *State* _____

ME 1-59

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.



WHY THINGS RUN SMOOTHER WHEN YOU SPECIFY HYATTS

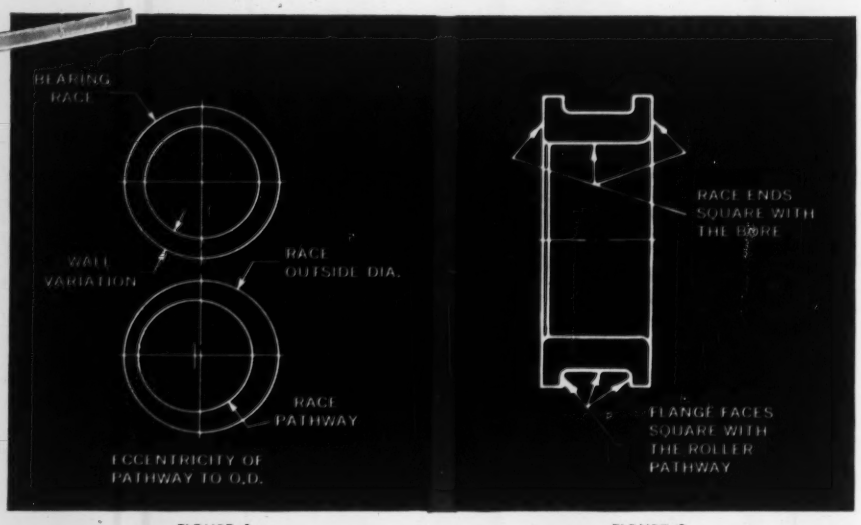


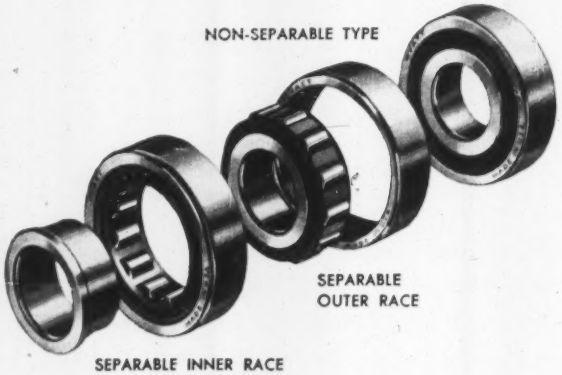
FIGURE 1 FIGURE 2

CLOSE CONTROL OF INTERNAL DIMENSIONS MEANS LONG, TROUBLE-FREE BEARING LIFE

The running accuracy and smoothness of a roller bearing is governed by the tolerances of its internal dimensions and clearance. Internal dimensions include concentricity of race diameters and squareness of all radial and axial surfaces, as briefly explained at right.

Because the internal dimensions of HYATT Hy-Roll bearings are so closely controlled, HYATTS run smoothly and quietly, last longer, and prevent equipment trouble due to excessive heat and vibration. You will find full selection and application data in HYATT Catalog 150, or call your nearest HYATT Sales Engineer. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.; Pittsburgh; Detroit; Chicago; and Oakland, California.

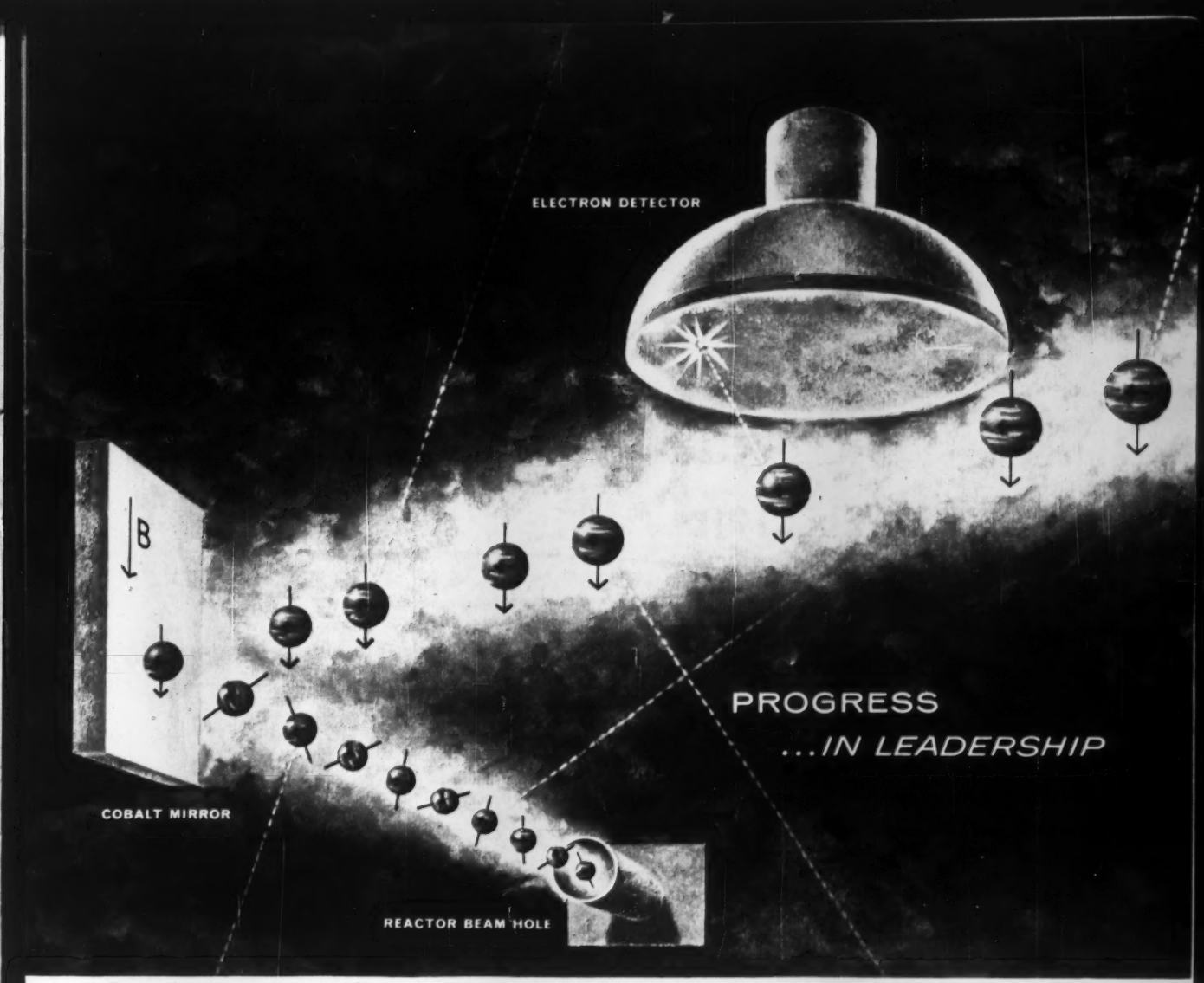
Concentricity of race diameters is usually defined in terms of wall variation (Figure 1) of the individual races, and radial run-out of the assembled bearing. Squareness of race and roller ends and flange faces is vital to prevent roller skewing with consequent heating and noisy operation. Figure 2 indicates the race surfaces which must be square with each other within minute tolerances depending on the grade of the bearing. The roller ends must also be square with the diameter for the same reason as above. End square tolerances are usually less than .001" for the most frequently used sizes.



THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

1908–1958 GM FROM THE PROGRESS OF THE PAST . . . THE PROMISE OF THE FUTURE

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY



measuring the free decay of polarized neutrons

A fundamental test of the various theories of beta decay which have been inspired by recent parity experiments is obtained from the quantitative measurement of the spatial asymmetry of the beta particles emitted in the decay of free polarized neutrons.

For these measurements, neutrons with identical spin directions were selected from a neutron beam from Argonne's CP-5 research reactor by reflection from a magnetized cobalt mirror. This technique for obtaining polarized neutrons was conceived and developed by Argonne scientists.

Argonne
NATIONAL LABORATORY
Operated by the University of Chicago under a contract with the United States Atomic Energy Commission

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P.O. BOX 299 · LEMONT, ILLINOIS

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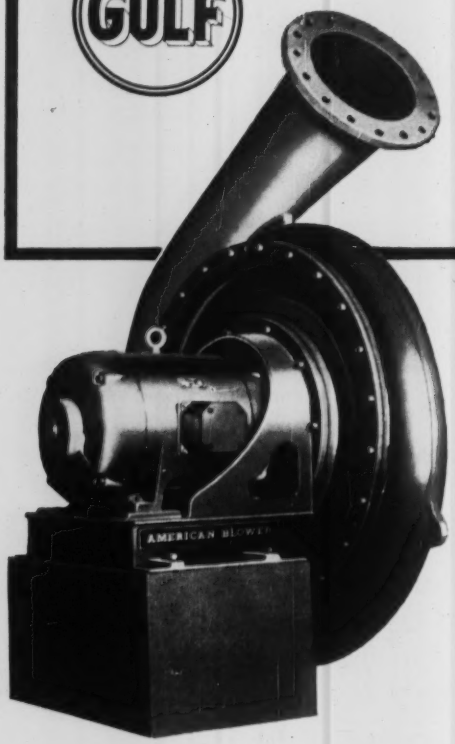

Names make news!

The names? You see some of them above — well-known names in business, whose judgment of a product, its quality and performance, is backed by long and practical experience.

The news? Each of them has selected an American Blower Centrifugal Compressor to handle an important job in their manufacturing process or end product.

American Blower Centrifugal Compressors are available in single-stage sizes — 25 to 2500 hp; pressures from ¾ to 7½ lb. (psig); volumes from 2000 to 140,000 cfm.

If you have an application calling for centrifugal compressors, call our nearest branch for full product information. American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

AMERICAN-Standard PRODUCTS

QUALITY PROTECTS YOUR INVESTMENT . . . AMERICAN-Standard QUALITY IS AVAILABLE AT NO EXTRA COST

THE MEANING OF FLEXITALLIC BLUE

In every field of high-pressure seal—for pipe flanges, pressure vessels, and process equipment—engineers know and recognize Flexitallic Spiral-Wound Gaskets. The blue dye in the Canadian asbestos filler provides positive product identification.

Flexitallic Blue tells the user that the gasket is made by an engineering organization devoted exclusively to the manufacture of Spiral-Wound Gaskets since 1912.

Flexitallic Blue is your assurance that the compression response of the gasket is directly related to the bolting for each application.

Flexitallic Blue is a pledge that manufactured gaskets always conform to specification.

When you see Flexitallic Blue, you can be sure it's a genuine Flexitallic Spiral-Wound Gasket.

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N.J.
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Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

* Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

Now teamed for Diesel Leadership

CURTISS-WRIGHT

"World's Finest Aircraft Engines"

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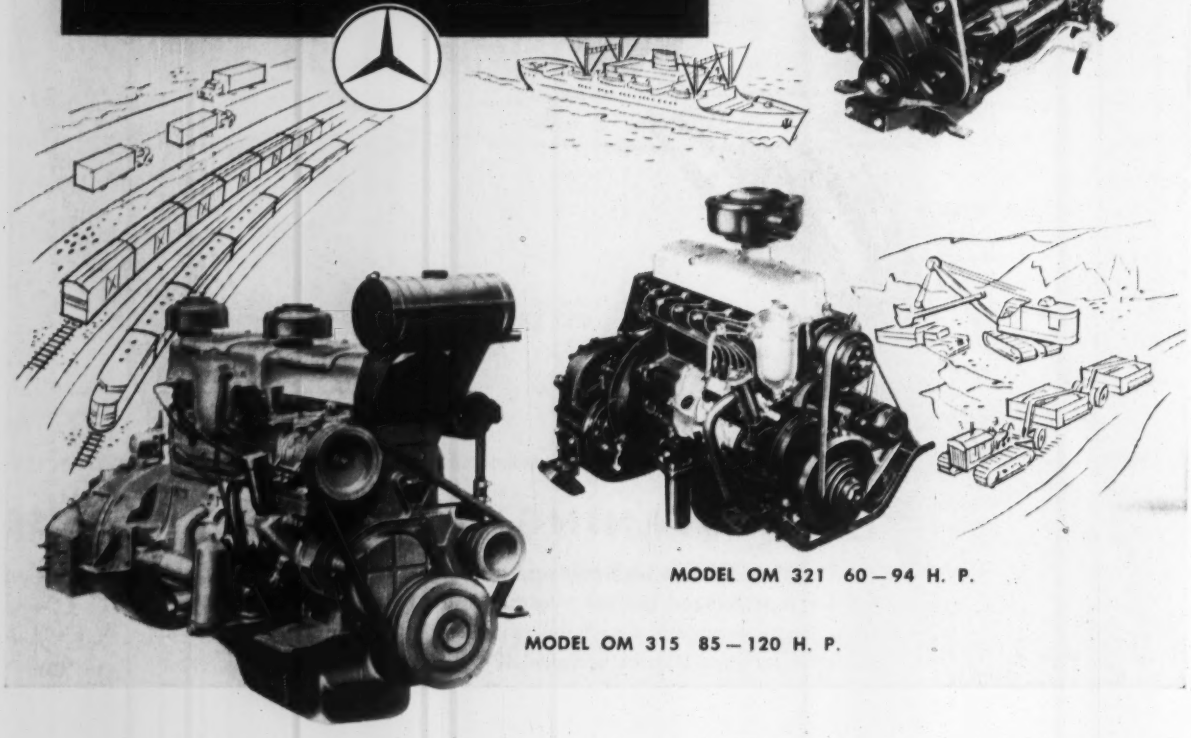
MERCEDES-BENZ

"World's Finest Diesel Engines"



MODEL OM 636 19—34 H. P.

MODEL OM 321 60—94 H. P.

MODEL OM 315 85—120 H. P.

Dependability . . . superior performance and economy . . . maximum power-to-weight ratio . . . these are some of the features that have made the name Mercedes-Benz world-famous – in Diesel engines as in fine automobiles. Now, Mercedes-Benz Diesels, in models ranging from 19 to 3,000 horsepower, are available through the Utica-Bend Division of Curtiss-Wright Corporation, for use by manufacturers and users of industrial, marine, construction and materials handling, transportation, electrical generating, agricultural, oil and gas equipment and vehicles.

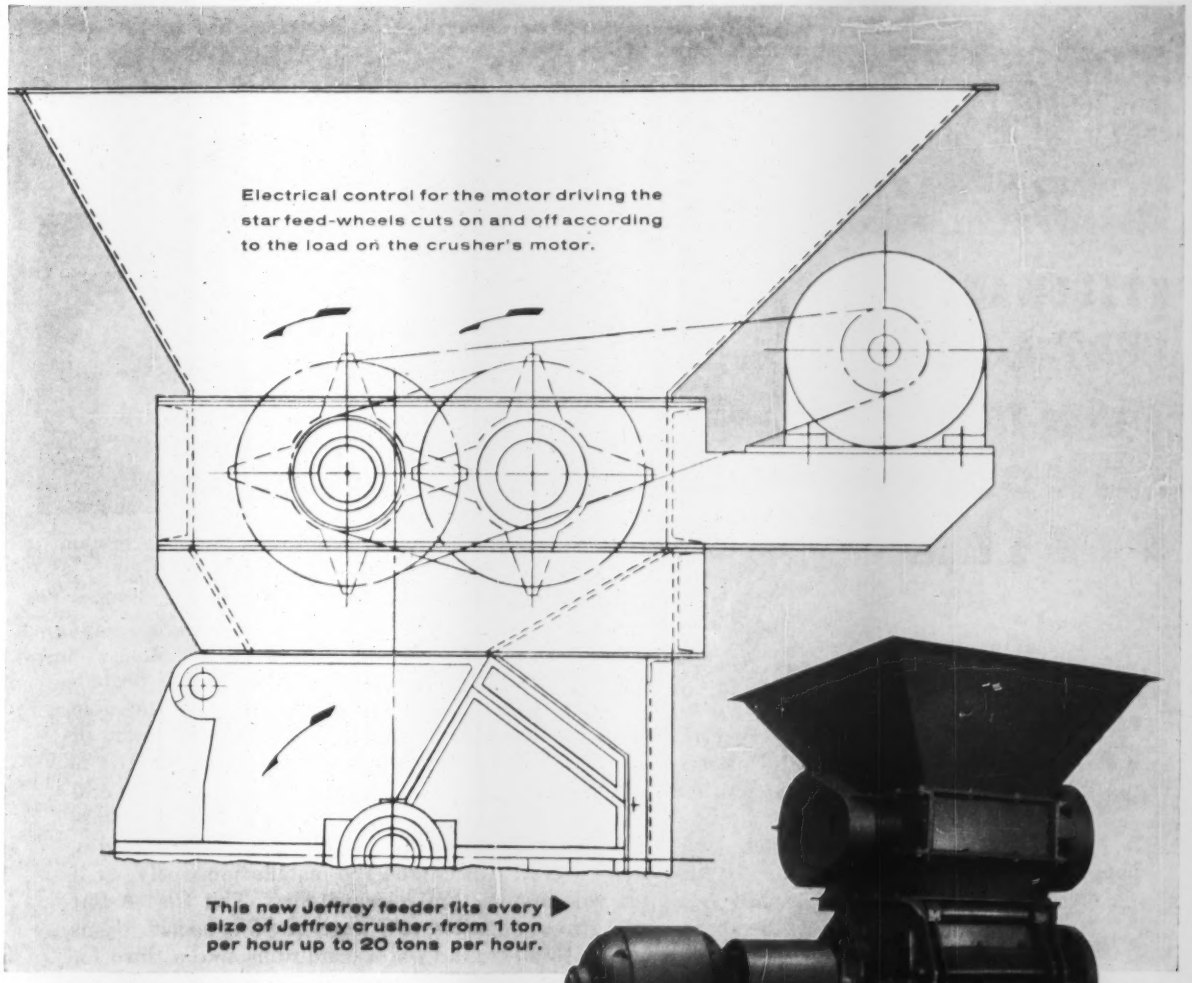
The Utica-Bend Division has factory sales and service offices in key areas and maintenance personnel trained at Daimler-Benz, A.G. in Stuttgart, West Germany, to assure full maintenance and spare parts stocks for all users of Mercedes-Benz equipment.

For complete information on Mercedes-Benz Diesel Engines, write on your business letterhead.

UTICA-BEND DIVISION

CURTISS-WRIGHT

CORPORATION • UTICA, MICHIGAN



Electrical control for the motor driving the star feed-wheels cuts on and off according to the load on the crusher's motor.

This new Jeffrey feeder fits every size of Jeffrey crusher, from 1 ton per hour up to 20 tons per hour.

NEW JEFFREY

Metal-Turnings Feeder

works crusher at full load and prevents stalling

• Metal turnings are profitable when they're reduced to a shoveling size. Jeffrey crushers perform that task well, simplifying handling, cutting costs for hauling, and permitting reclamation of valuable oils.

But feeding a crusher has always been a problem, with workers tugging and shoveling, while taking care not to stall the motor by crowding the crusher. Jeffrey's new metal-turnings feeding device cuts labor to a minimum, while keeping the crusher working at maximum capacity.

The hopper takes 2 to 3 cubic yards of turnings, so it can be filled directly from tote boxes or magnets. The star wheels force turnings down into the crusher until its drive motor "complains" to the electrical controls. The feed shuts down temporarily, but starts again as the load slacks off.

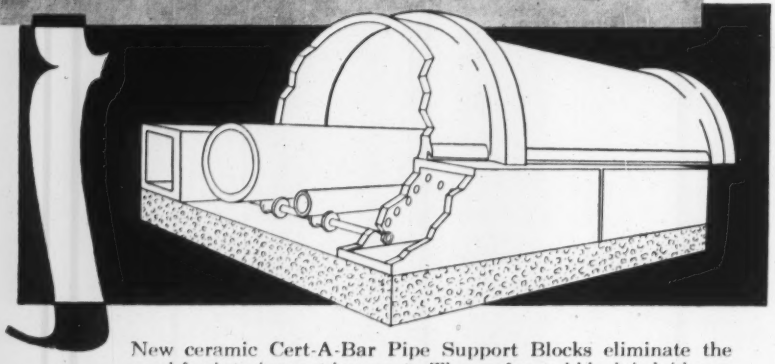
For complete data, get in touch with The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

CONVEYING • PROCESSING • MINING EQUIPMENT . . . TRANSMISSION MACHINERY . . . CONTRACT MANUFACTURING

JEFFREY

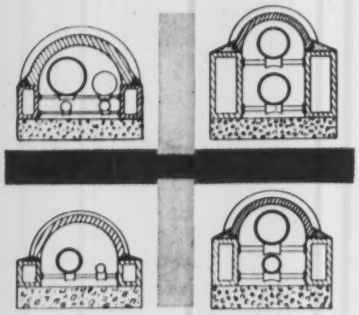
PERMANENT PROTECTION
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

WRITE FOR

illustrated, four-page circular with complete installation specifications.

*T.M. Reg. App. For. Patents Pending

The Stillwater Clay Products Co.
STILLWATER CONDUIT DIVISION
3334B Prospect Ave., Cleveland 15, Ohio

STILLWATER CONDUIT SYSTEMS

A NEW AID FOR COST-CONSCIOUS MANAGEMENT

You can now determine just how much productivity you are losing because one or more elements of the operating cycle of an automated machine are not perfectly timed.

Now you can spot any timing error to within a 60th of a second immediately.

Cycle Analysis

Sheffield's new Monitorecord* system analyzes timing by means of a printed, composite time graph. This shows every start, dwell and stop of each interrelated event in the complex machine cycle — just as it occurs.

Corrective Adjustment

When a Coded Master is laid over the time graph you see just what adjustments are needed and the amount of each. No tedious groping — no costly down-time.

What could serve Preventive Maintenance more effectively than taking such a graph every day? What could save as much set-up time? This system often justifies its cost the first time it is used.

System installation is no problem. It can be applied to machines now in service or it may be built into new machines.

The readily portable Monitorecord is merely plugged into the system receptacle of any machine requiring cycle analysis. It can be moved about at will.

Get all the facts on this profit-conserving idea. Write to the *Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 41.*

*Trademark

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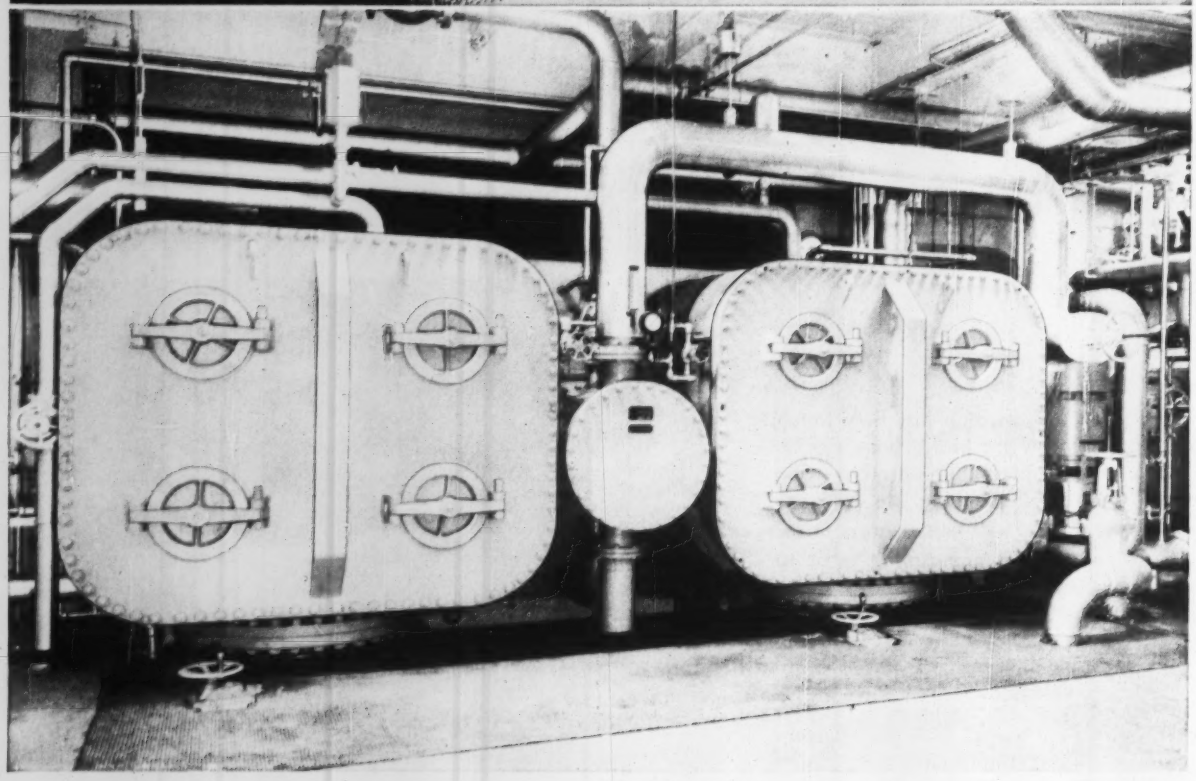
of Bendix

manufacture and measurement for mankind

PROGRESS IN POWER through PROGRESS IN HEAT TRANSFER EQUIPMENT



NEW-DESIGN CONDENSERS SAVE SPACE AND MONEY

Steam generation of electricity has made tremendous progress in the last 25 years because of the ever-increasing efficiency of the equipment used.

A power equipment manufacturer with many "firsts" to its credit, Yuba is continually designing, among other equipment, condensers with low head room to save much-needed space. This advancement is illustrated above in the photograph of a rectangular shape condenser for the Suwanee River Plant of the Florida Power Corp.

A low pressure heater is installed between the tube banks to further save plant space, as well as initial cost for foundation and piping. An additional design feature of Yuba condensers is a de-aerating section within the condenser shell which eliminates the main plant de-aerating heater. Maintenance and downtime costs are reduced by welding tubes into tube sheets.

For advanced condenser design, that will save space and money, consult the Yuba Heat Transfer Division, formerly the Heat Exchanger Division of The Lummus Co.

YUBA

CONSOLIDATED INDUSTRIES, INC.

Other Divisions Manufacturing Heat Transfer Equipment
California Steel Products Division, Richmond, Cal.
Adsco Division, Buffalo, N. Y.

YUBA HEAT TRANSFER DIVISION
HONESDALE, PENNSYLVANIA
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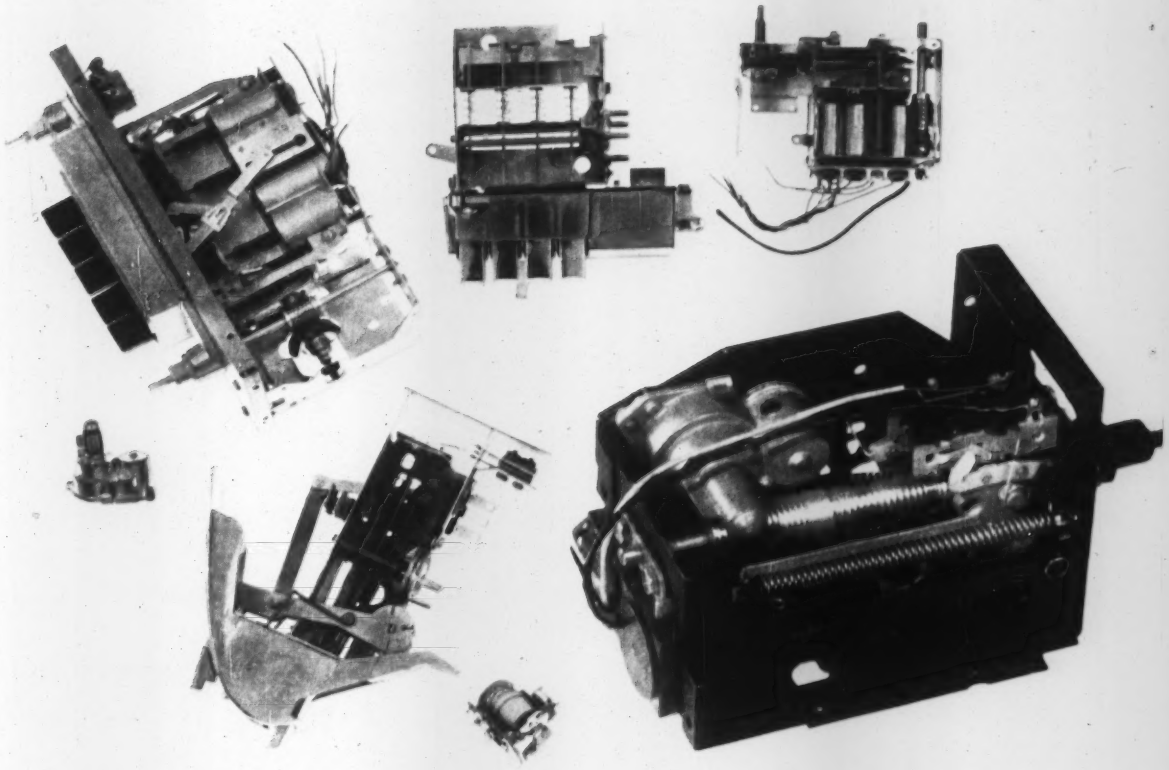
STEAM JET REFRIGERATION • STEAM JET AIR EJECTORS
FEEDWATER HEATERS • BAROMETRIC CONDENSERS



HERE'S AN OPPORTUNITY TO HAVE AN INTERESTING PART IN A SECURE FUTURE. AVAILABLE NOW ARE NEW JOB OPPORTUNITIES IN MECHANICAL ENGINEERING FOR GRADUATE ENGINEERS INTERESTED IN MECHANICAL AND ELECTRO-MECHANICAL FIELDS.

Delco Radio is unique in the electronics industry in that we engineer and manufacture most of the wide variety of parts used in our products. Because of continued expansion, we need men with engineering experience, as well as recent college graduates, to develop electro-mechanical devices and control mechanisms for high-volume production. We have long-term objectives in this area that broaden to most fields of research, design and development. Initiative and ability get quick recognition. And your future is backed by solid General Motors benefits such as retirement, stock savings, and complete insurance programs, as well as an advanced degree program with a leading university. Place of employment: Kokomo, Indiana—"An engineer's town"—where living is pleasant for all the family.

Address your inquiry and résumé of your training and experience to: Salaried Employment Supervisor, Dept. D.

GM GENERAL MOTORS

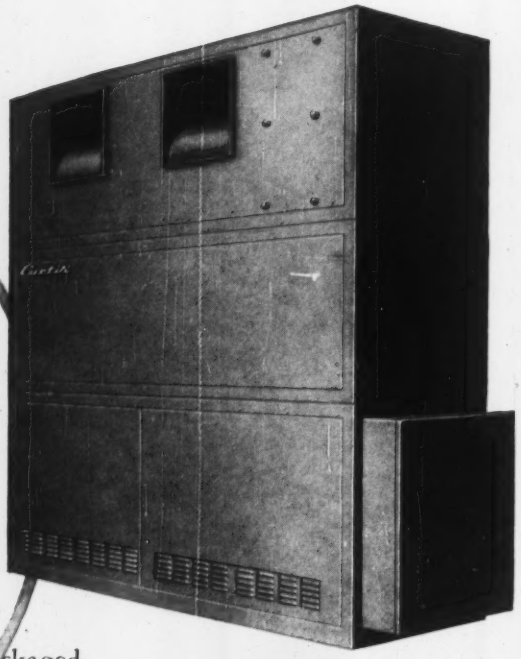
DELCO RADIO

Division of General Motors, Kokomo, Indiana

NOW!

Curtis

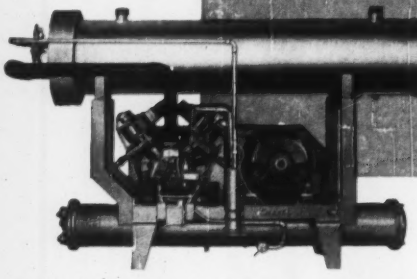
PACKAGED UNITS
Up to 50 Tons
OPENS NEW MARKETS FOR PACKAGED AIR CONDITIONING



No question about it. The new 50-ton Curtis packaged air conditioner will open a new sales front for you. Architects, engineers *and* owners prefer packaged units for important reasons:

- Big package units are line assembled—does away with expense of field labor. Assures a BALANCED SYSTEM.
- Packaged units are easier to install—take up less space.
- Cuts down installation problems and maintenance costs.

IMPROVED PACKAGED LIQUID CHILLER... FOR WET HEAT SYSTEMS



up to 100 tons—

With all controls in single panel box for easier access and greater protection! Four step capacity control—unloaded starting available. Particularly desirable where year 'round conditioning of multiple individual rooms is required.

REMEMBER, every Curtis unit is backed by a solid 103 years of experience and skill. Curtis offers a complete line of air conditioning equipment—nationally advertised to help you sell.

YOU CAN COUNT ON

REMEMBER...

Curtis

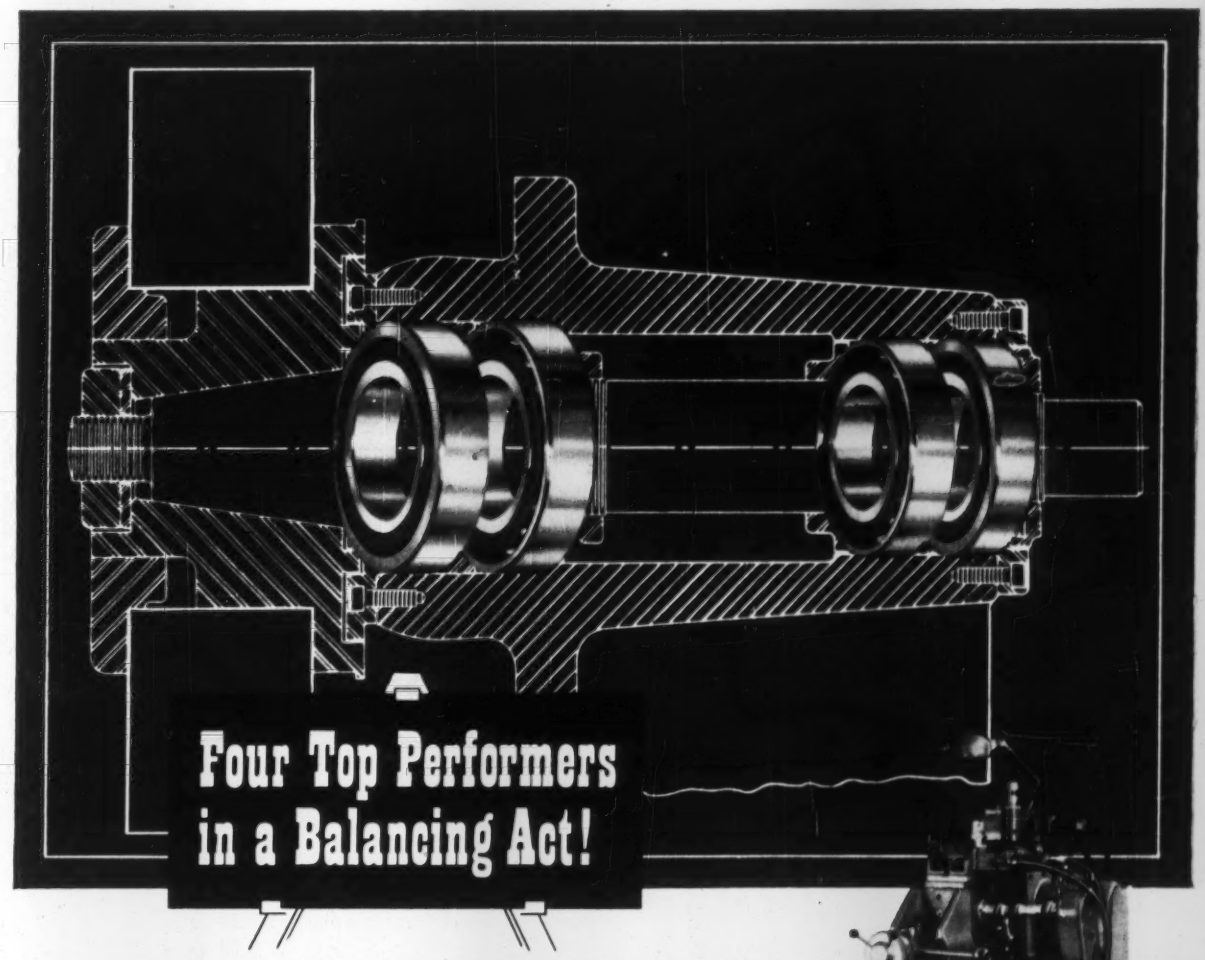
OUR 103rd YEAR

MANUFACTURING COMPANY
REFRIGERATION DIVISION
1940 Kienlen Ave. St. Louis 20, Mo.
CM-16

New Curtis Packaged, Air Cooled, Air Conditioning Units, 3 thru 7½ tons. Residential and commercial applications.

Condensing Units up to 100 tons. F-12 or F-22.

Air Handling Units, Cooling Towers and Evaporative Condensers to match.



Four Top Performers in a Balancing Act!

To assure true spindle balance, close running accuracy, and vibrationless performance, Royal Master mounts the massive, heat-treated alloy work wheel spindle of its TG-12 centerless grinder on four Fafnir Super Precision Ball Bearings. The spindle assembly itself is mounted directly into the normalized, stress-relieved, close-grained grey iron head stock.

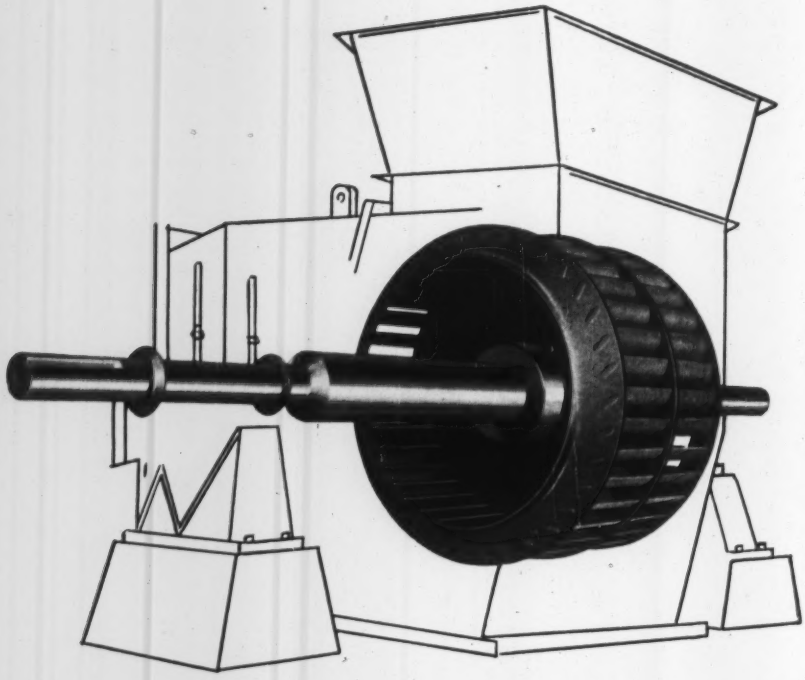
Besides providing proper balance and smooth spindle operation, the Fafnir Preloaded Super Precision Ball Bearings used in the TG-12 eliminate spindle warm-up time—an important feature where the machine is used intermittently. Moreover, relubrication of the bearings is never required. They are lubricated for life when the machine is assembled.

This Royal Master bearing application is a typical example of the Fafnir "attitude and aptitude"—a way of looking at bearing requirements from the designer's point of view and coming up with the right bearing to fit the need. Perhaps the Fafnir approach can be of help to you in finding more economical and satisfactory answers to bearing problems. Write The Fafnir Bearing Company, New Britain, Connecticut.

Royal Master TG-12 Centerless Grinder, Fafnir equipped, is designed for thru-feed, plunge feed, and infeed grinding. It has successfully ground materials ranging from plastics to tungsten carbide. Features include accessibility of both sides of wheel from operating position, for high output and fast checking.

◀ Fafnir preloaded, angular-contact, super-precision ball bearings with composition or bronze retainers are made to highest industry-approved tolerances. Single or duplex bearings like this are used widely on spindle applications.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA



CLARAGE TYPE DN DYNACURVE FAN OFFERS A *New Concept* IN INDUCED DRAFT WHEEL DESIGN

36 radially deep, aerodynamically curved blades impart a dynamic energy to the gas stream to achieve low tip speed operation.

Unique shape of the blades and rims minimizes shock losses and turbulence at the entering edge of the blades and between the blades.

Wheel design assures relatively low moment of inertia (WR^2).

Wheel is constructed with a heavy forged steel hub and a sturdy centerplate.

All welded construction of the wheel provides ample shear strength, tensile strength, and rigidity.

These are only a few of the features that make Clarage's new Type DN Dynacurve Fans fully equal to the most punishing demands.

Write today for Bulletin 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

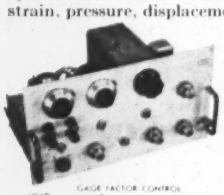
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

TECHNIQUES and DEVELOPMENTS
in oscillographic recording

FROM
SANBORN

CIRCUIT DESIGN AND TYPICAL USES OF THE "150" CARRIER PREAMPLIFIER

One of the most frequently used plug-in front ends for Sanborn 150 Series oscillographic recording systems is the Model 150-1100 Carrier Preamplifier, since with it a "150" system can record such variables as force, temperature, strain, pressure, displacement, velocity, flow, acceleration — or any variable which can be expressed as a suitable input signal by a transducer. The "1100 Carrier" will operate with a variety of different transducers and bridge circuits, which will be mentioned later on.



In the block diagram (Fig. 1),

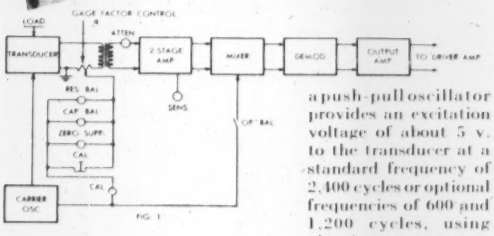


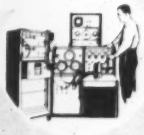
FIG. 1

a push-pull oscillator provides an excitation voltage of about 5 v. to the transducer at a standard frequency of 2,400 cycles or optional frequencies of 600 and 1,200 cycles, using plug-in components. This excitation voltage also feeds the Balancing, Calibration and Zero Suppression circuits. (The Balancing controls allow correction of resistive and reactive signal leakage from the transducer, so that at zero load the net signal to the Preamplifier is zero. The Zero Suppression feature permits bucking out a large static load so that a small part of the load can be expanded over the full recording chart. The Gage Factor control allows the zero suppression range to be made equivalent to some convenient transducer load, or the full load rating of the transducer, and also causes the calibration signal to represent 2% of that load.) Transducer output is fed to the transformer through the Gage Factor potentiometer, across which the Balancing-Calibration-Zero Suppression circuits develop a voltage effectively in series with the transducer output. The mixer receives a suppressed carrier AM signal and re-inserts a carrier component, to make its output a conventional AM signal whose modulation represents the transducer load. The modulation signal (whose amplitude and polarity represent magnitude and direction of transducer output) is recovered by the demodulator and fed to the output amplifier, which in turn excites the Driver Amplifier and recording galvanometer of a "150" system.

Transducers which may be used with the Carrier Preamplifier include strain gage half-bridges or full-bridges, commercial resistance or reactance bridges, differential transformers and resistance thermometer bridges. The transducer chosen should provide at least 18.0 microvolts per volt of excitation at the minimum load to be recorded, for a one cm. deflection; impedance should be 100 to 1000 ohms. With strain gages, normal operation provides sensitivities of 50, 20 or 10 micro-inches per inch for each cm. on the recording, depending on the number of active gages. With resistance thermometers, if 1°C. or 2°F. per cm. stylus deflection is sufficient sensitivity, the user can construct his own resistance thermometer by including a 3 ohm coil of copper wire in one arm of an equal arm 100 ohm bridge.

Helpful information about the use of transducers with the 150-1100 Preamplifier is contained in the following Sanborn RIGHT ANGLE articles (reprints on request): Coupling Differential Transformers, Aug. and Nov. 1956; Filter Networks for use with Force Dynamometers, Nov. 1956; Calibration with 1-, 2- or 4-arm Strain Gage Bridges, Aug. 1955; Theoretical and Actual Applications of Bridge Circuits, May and Aug. 1954.

Wing flutter recording to infrared research . . . with the versatile "1100 Carrier"



Today, Carrier Preamp-equipped Sanborn "150" systems are being used for frequency response tests of process control system components; to record shaft deflections of fluid mixing equipment; in infrared research . . . vehicular traffic studies . . . submarine hull vibration measurements. Applications are limited only by the transducers available.

These are applications of only one "150" front-end; eleven more interchangeable, plug-in Preamplifiers increase the scope of Sanborn oscillographic recording systems to meet an almost infinite variety of research, production and field testing requirements. All Sanborn "150" direct writing systems record inkless traces in true rectangular coordinates; all provide 1% linearity; Basic Assemblies — equipped with your choice of Preamps — are available from one- to eight-channels, packaged in vertical cabinets, portable cases, or specially modified housings.

Technical data and help with your oscillographic recording problem are always available from Sanborn.

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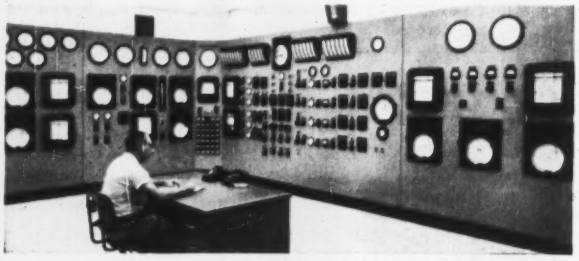
● Adjusts fuel, air and water as steam flow changes ● Makes follow-up adjustment of header pressure and water level if needed ● Prevents (rather than corrects) most pressure, level and temperature fluctuations before they happen!

Planned expansion of power in the Southeastern United States is typified by the addition of Unit #3 to South Carolina Generating Co.'s Urquhart Station. Rated capacity of the steam generator is 700,000 lb/hr at 1825 psi, superheated to 1010 F and reheated to 1010 F. Designed by Gilbert Associates, Urquhart #3 is modern in performance as well as appearance.

REPUBLIC's "Electronic Master" combustion control and triple-element feedwater control permit firing of pulverized coal, natural gas, or both at once without fluctuation of header pressure or water level. This system starts adjusting fuel, air and water as soon as steam flow changes perceptibly, not waiting for either drum level or header pressure to change.

If either of these factors change despite the preliminary adjustment, the change will be very small and will be offset immediately by a follow-up control that modulates the existing control signal. Since the flow of flue gas is held in such close proportion to the steam flow, temperature at the superheater outlet is held very close to a constant 1010 F despite load swings.

This advanced control system is a logical partner to the advanced thinking apparent throughout Urquhart #3. The quick action of electronic control added to the traditional reliability and power of pneumatic actuation produces a stable, accurate, dependable automatic system. And any one or all of the automatic control functions can be cut out at will to permit substitution of remote manual control at any time. Manual controls include indicators for electronic loadings of the regulators and positioners as well as position and rate of response indicators.



Control room of Urquhart Station's modern Unit #3.

NEED HELP on "Early Stage" Planning?

Remember that Republic, too, is planning ahead. To get the latest information on developments that will effect control in your future power or processing plant, contact the REPUBLIC Engineering Department as soon as such help would be beneficial.

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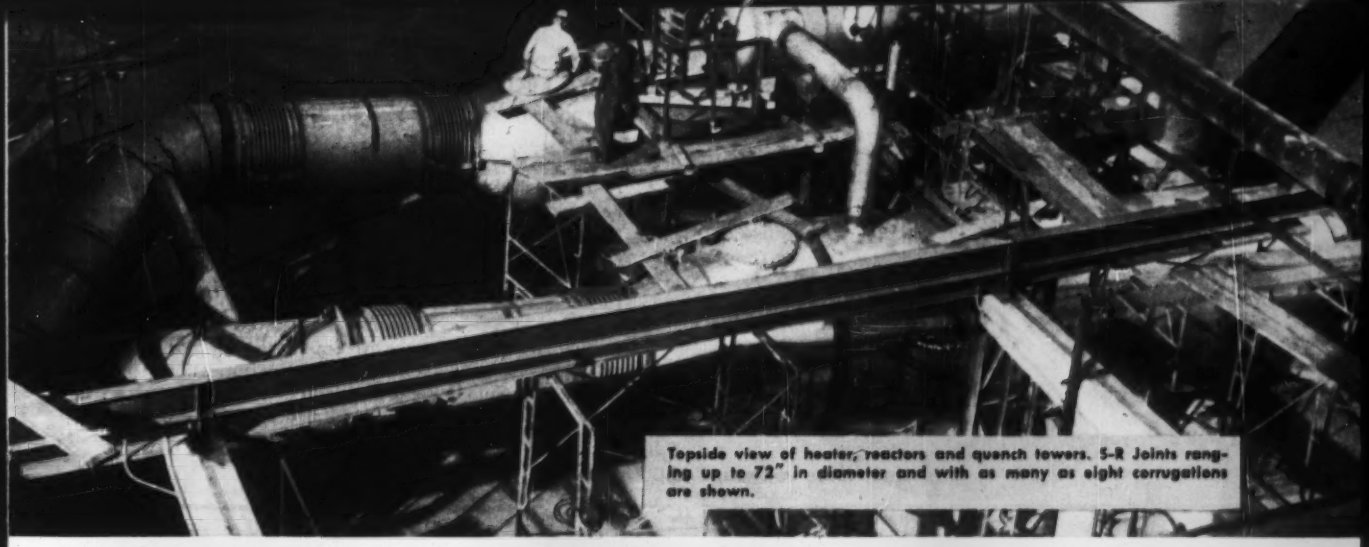


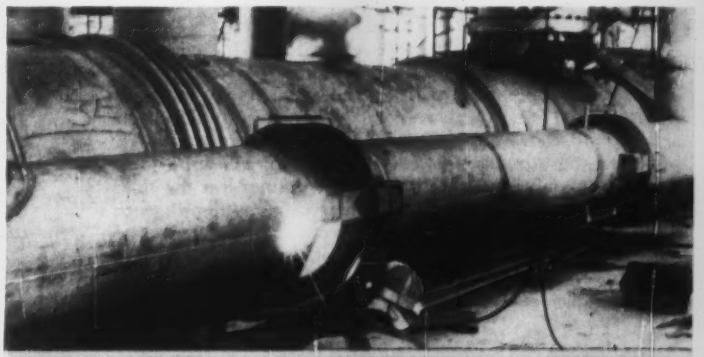
Topside view of heater, reactors and quench towers. S-R Joints ranging up to 72" in diameter and with as many as eight corrugations are shown.

188 Badger Expansion Joints Protect Equipment in Texas Butadiene's New Plant

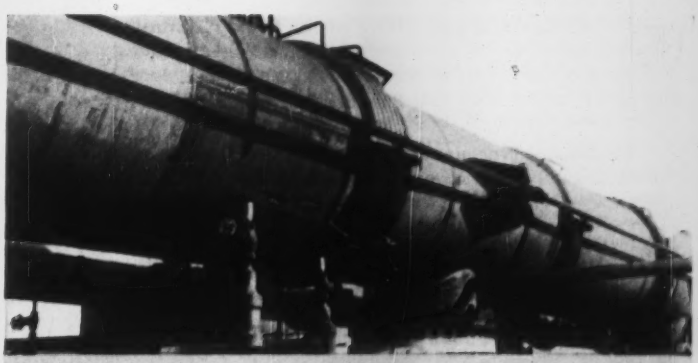
At the time Texas Butadiene's new plant was designed, engineers figured that the high temperatures required by the process would cause excessive pipe expansion — and possible damage to equipment. They solved this critical operating problem by specifying Badger S-R Expansion Joints — *to absorb and control pipe movement.*

Now — with a total of 188 Badger Expansion Joints in operation (ranging in size from 14" to 72") — Texas Butadiene's new plant at Lyondell, Texas is making processing history. Designed to solve just such exacting expansion problems, the Curvilinear Corrugations and tubular Reinforcing Rings of S-R Expansion Joints insure better equalization and longer cyclic life (see diagrams below).

Size for size, new Badger S-R Joints weigh up to 50% less than conventional types . . . and their new ring design reduces joint diameter. A complete line of accessories — including covers and liners — is available. *Write today for fully illustrated brochure.*



Large line (air in — air out — product out) under reactors includes twelve S-R 48" stainless steel joints to handle temperatures of 1150° F. at 35 psig. Small evacuation line uses fourteen 16-inch S-R Joints.



Close up of Regeneration Air Line. This line has fourteen 48" stainless steel S-R Joints handling temperatures over 1000° F.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer joint life.

Series 150 corrugation and ring cross-section

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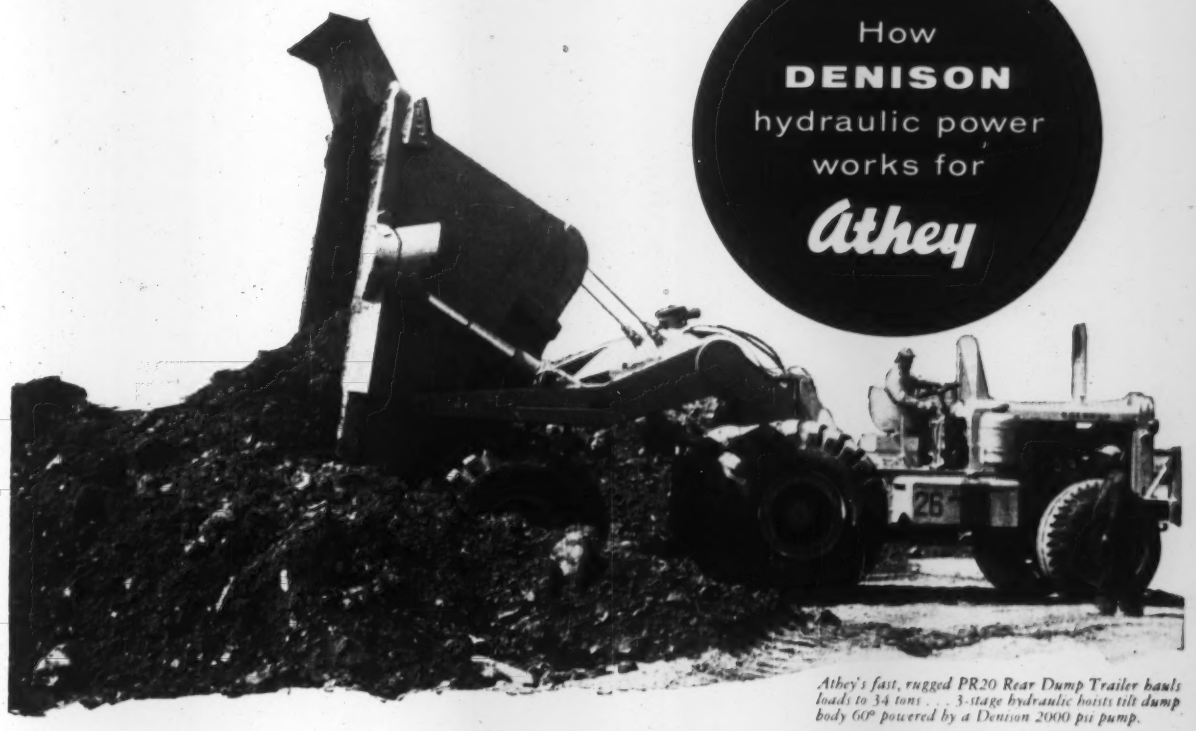

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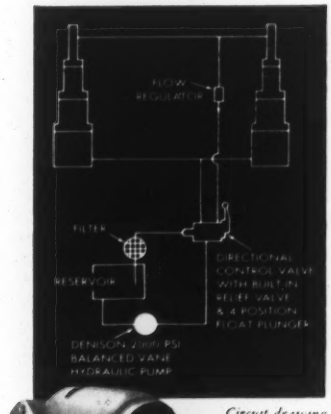
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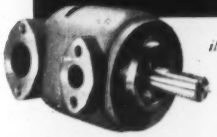

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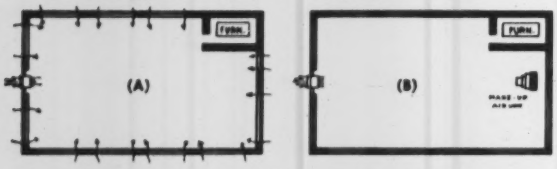

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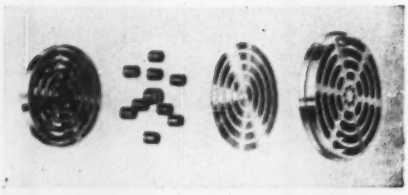

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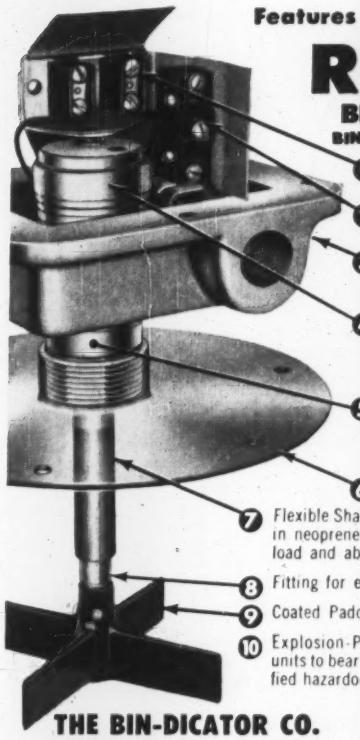

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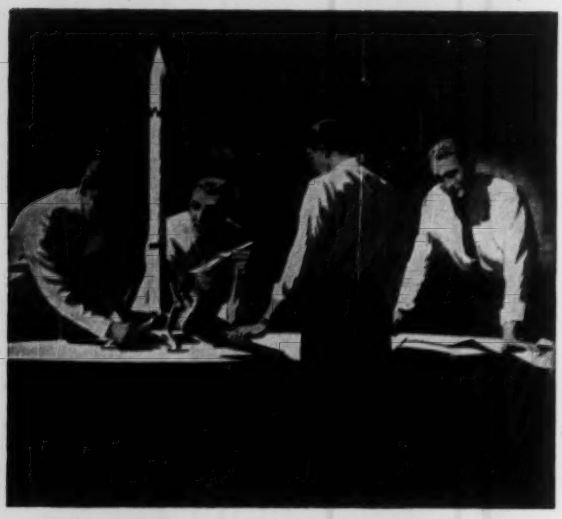

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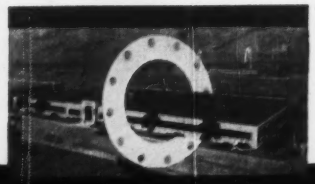

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- More than 35 years experience in die-cutting non-metallic materials.
- We are equipped to slit rubber slabs up to 12" thick — or, to die-cut materials as thin as .001" onion skin shim paper.
- Difficult adhesive coated, or impregnated materials are easily handled through our unique cutting process.
- Materials handled and stacked include paper, asbestos, fibre, rubber, cork, felt, synthetics and many miscellaneous materials.
- All steel rule dies are made in our own plant.

Ask about our technical and consulting service.

Rhopac, Inc.

3433 Cleveland Street, Skokie, Illinois

Manufacturers of mechanical packings, industrial and boiler gaskets, radio speaker gaskets, steel rule dies, flexible packing hooks

Ametron® ELECTRONIC

CRANE SCALES

Weighs heavy loads suspended from crane hook. Printer, located in crane cab or other convenient location, records weight on tape or cards. New compact printer only 22" x 18" x 10½".

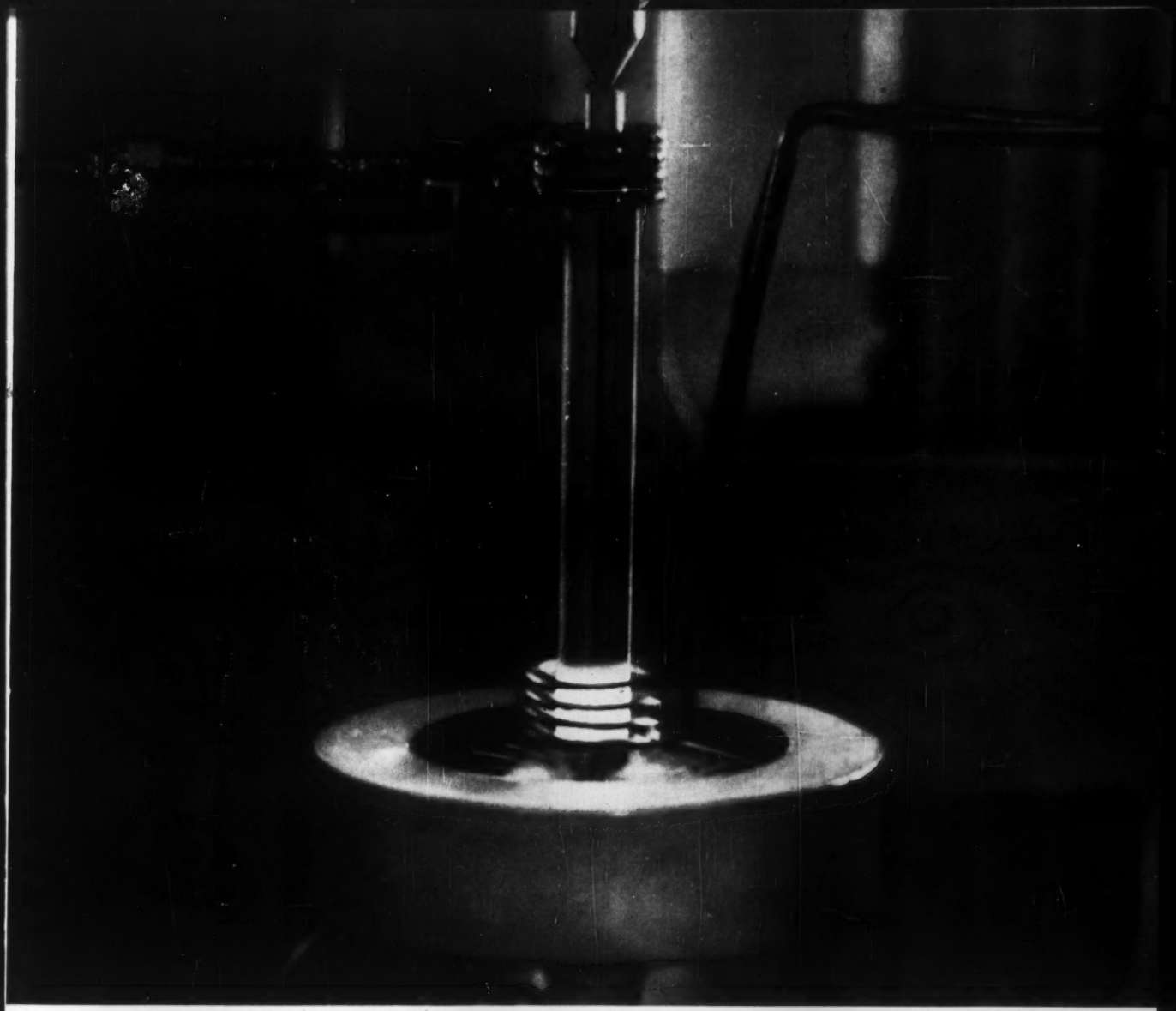
Entire assembly designed for prompt and easy installation. Now available at new low cost. Capacities 5, 10, 15 tons.

Write for Free Ametron Brochure 9

STREETER-AMET COMPANY

GRAYSLAKE, ILLINOIS

THE STANDARD OF ACCURACY SINCE 1888



Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

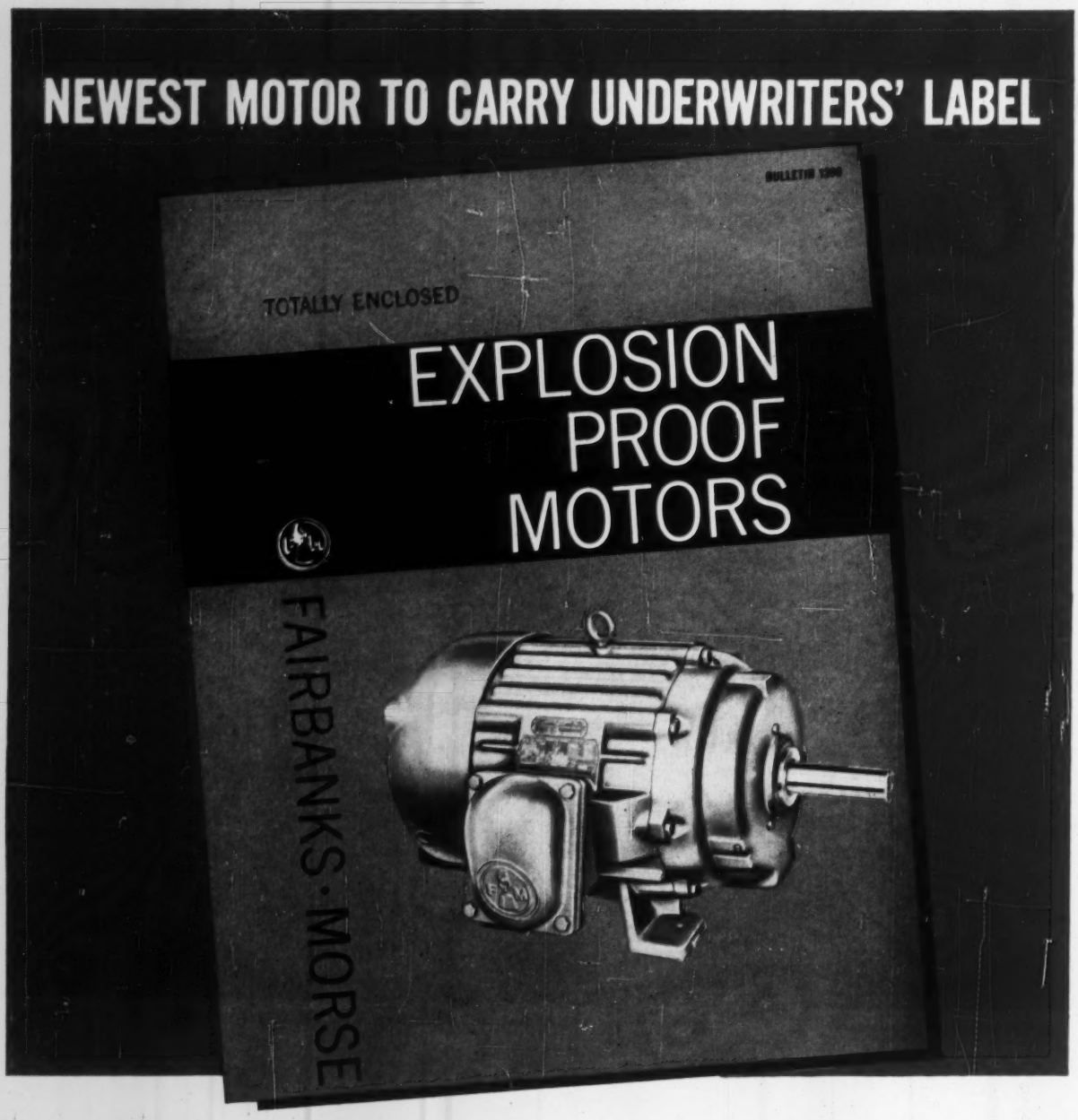
If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

NEWEST MOTOR TO CARRY UNDERWRITERS' LABEL



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All new inside and out—new, rugged frame design . . . for new, improved performance in all Class I, Group D, and Class II, Group E, F and G hazardous locations.

Get full information . . . send for Bulletin 1200 on new Fairbanks-Morse line of totally enclosed, explosion-proof motors. Write today: Fairbanks, Morse & Co., Dept. ME-12, Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

Opportunities

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 20th of the month preceding date of publication.

POSITIONS OPEN

MECHANICAL ENGR-POWER

Recent Grad, veteran, to understudy plant engineer, chemical co., Indianapolis location. To $7500 year depending upon experience. Write age, education, experience.

Address CA-6358, % "Mechanical Engineering"

VALVE AND NUCLEAR ENGINEERS

Aggressive Research and Development activities have made Edward Valves Inc., a leader in the steel valve industry.

We have expanded our Research facilities to maintain this position.

Openings are for Engineers (mechanical, stress, flow, materials, metallurgists) interested in design and development of valves for high pressure, high temperature service and nuclear power applications. Replies are confidential.

EDWARD VALVES, Inc.
Subsidiary of the Rockwell Manufacturing Company
1200 West 145th Street, East Chicago, Indiana
Mr. E. A. Loeser, Engineering Personnel

SALES ENGINEER
DESIGN ENGINEER

Mechanical Engineers for either design or sales may find an opportunity with us, either designing or selling coal valves, coal scales and related items. Several new products will make the work interesting and create opportunities.

Sales engineer preferably should have a knowledge of coal fired steam boiler operation. Design engineer preferably should have experience with machine tool design, gear reducer design or design of similar items.

We are looking principally for trainees but we expect to hire one or two older men. If you would like to work for a small, active company where you know everybody—this is the position for you!

Write to: Daniel A. Hill, Stock Equipment Company, 745 Hanna Bldg., Cleveland 15, Ohio

Immediate Opening
CRUCIBLE STEEL COMPANY OF AMERICA

Central Research Laboratory
Pittsburgh, Pennsylvania

MECHANICAL ENGINEER

Requires advanced degree in mechanical engineering or metallurgy with experience in both technical disciplines. Should have a minimum of ten years' experience in development of metal working processes and equipment. Competence in handling engineers associated with the working of metals is desirable.

Send resume in complete confidence to

Mr. J. E. Harris
CRUCIBLE STEEL COMPANY OF AMERICA
P. O. Box 88, Pittsburgh 30, Penna.

ENGINEER — MECHANICAL

Calif. Slush Molder of Vinyls. Capable of Designing, Supervising, Construction, Automatic Vinyl Slush Molding Machines. Excellent opportunity with small, fast growing aggressive mfr. Give complete resume, salary requirements for interview.

Address CA-6368, % "Mechanical Engineering"

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Machine design. Experienced. Light to medium equipment for pulp and paper manufacturing. Requires familiarity with standard machine components and with shop and foundry practice. Send recent photo and complete resume of education, experience, and family status. Advise best time for interview.

Central States Engineering, Inc.
1000 West College Avenue
Appleton, Wisconsin

SPECIAL MACHINE DESIGN AND PRODUCT DEVELOPMENT

Graduate mechanical engineer, 5 to 15 years' experience for professional engineering organization, engaged in product development and design for industrial clients, and the government. Work is interesting and diversified and calls for exercise of individual ingenuity. Opportunity for substantial professional achievement. Location Southwestern Ohio.

Address CA-6376, % "Mechanical Engineering"

Mechanical Engineer

Southern Research Institute has several openings offering outstanding opportunities in research and development work in our rapidly expanding Engineering Division. Here is a chance to do creative work of a highly diversified nature. Work areas are in fluid flow, measurement and analyses of properties of materials at elevated temperatures, and specialized design and development.

Please send resume to:

Southern Research Institute
Birmingham, Alabama

Use a CLASSIFIED ADVERTISEMENT *for Quick Results*

SALES ENGINEERS

Recent Engineering graduates, preferably M.E., for approximately one year inside sales training prior to assignment to a territory. Send complete resume to Personnel Department.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
1200 West 145th Street
East Chicago, Indiana

MECHANICAL ENGINEER

B.S. or M.S. Degree
Married—Age 30–35

Attractive staff position with promising career opportunity with large nitrate mining company Chile, South America. Construction and maintenance experience heavy duty mine plant railroad equipment desirable. Three year contract, salary $650-$750, paid transportation. Write fully with small photo giving educational background, experience and salary expected.

Address CA-6365, % "Mechanical Engineering"

MECHANICAL ENGINEER

Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering"

ETHYL CORPORATION

We are seeking engineers for our Baton Rouge, Louisiana plant. Salaries commensurate with training and experience, excellent benefit plans.

MATERIALS HANDLING ENGINEER: Graduate mechanical or industrial engineering, 25-35, with minimum of 5 years' experience in industrial bulk materials and container handling methods in chemical industry.

TECHNICAL INSPECTOR: graduate mechanical engineer, 25-35, with minimum of 5 years' experience in inspection of chemical plant or refinery equipment. Pressure vessel design or fabrication will be considered in part as experience credit.

Interested applicants are invited to submit resumes of training and experience to:

R. S. Asbury
Ethyl Corporation
P.O. Box 341
Baton Rouge, Louisiana

DU PONT NOW OFFERS CAREER POSITIONS OF CHALLENGE AND RESPONSIBILITY IN SPECIALIZED AREAS OF MECHANICAL ENGINEERING

The Engineering Service Division of du Pont's Engineering Department provides consulting service and technical assistance to production, maintenance, design, research, and construction groups within the Company. The Division's objectives are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating costs, and in increasing capacity.

These openings are immediately available for experienced graduate engineers to provide consulting service to operating plants in the following specialized mechanical engineering fields.

PUMPS & COMPRESSORS—Desired qualifications will include extensive engineering knowledge of and familiarity with equipment used in the fluid mechanics field. Development, research, design, maintenance, or teaching experience in the fields of pumps, compressors, jets, and seals is desirable. Responsibilities of the position will involve selection of equipment, trouble-shooting, and consultation on fluid flow and mechanical design aspects of piping, pumps, jets, compressors, and seals. Duties include evaluation of available equipment and recommendations for equipment modification for special applications.

WATER—The desirable qualifications include a comprehensive knowledge of water conditioning for industrial plants. Practical experience with water procurement, with operation of facilities for treating water for boiler feed, process, and drinking purposes and with waterside boiler inspections is important. The successful applicant will provide engineering advice to those designing, constructing, and operating company plants on problems involved in the procurement and treatment of industrial water supplies.

POWER—Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic evaluations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

APPLIED MECHANICS—Qualifications include 5 or more years' experience in machine design, teaching or machine development involving the study and testing of structures, and pressure vessels. Practical knowledge of and experience in vibration, dynamic effects, and specification of engineering materials is desirable. Successful applicant will provide consulting service to design groups, plants, and laboratories on vibration problems and on dynamic and static stress analysis of machine components and chemical plant equipment.

NEW YORK CITY INTERVIEWS

Sun-Mon-Tues-Wed
December 1-2-3-4
For an appointment, please call
Mr. K. S. Marlin, Jr.
PEnnsylvania 6-5877

CHICAGO INTERVIEWS

Sun-Mon-Tues-Wed
December 8-9-10-11
For an appointment, please call
Mr. K. S. Marlin, Jr.
WAbash 2-7992

or you may send complete resume, including details of education and experience, to:

Mr. K. S. Marlin, Jr., Engineering Department

E. I. du Pont de Nemours & Co., Inc.

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Better Things for Better Living
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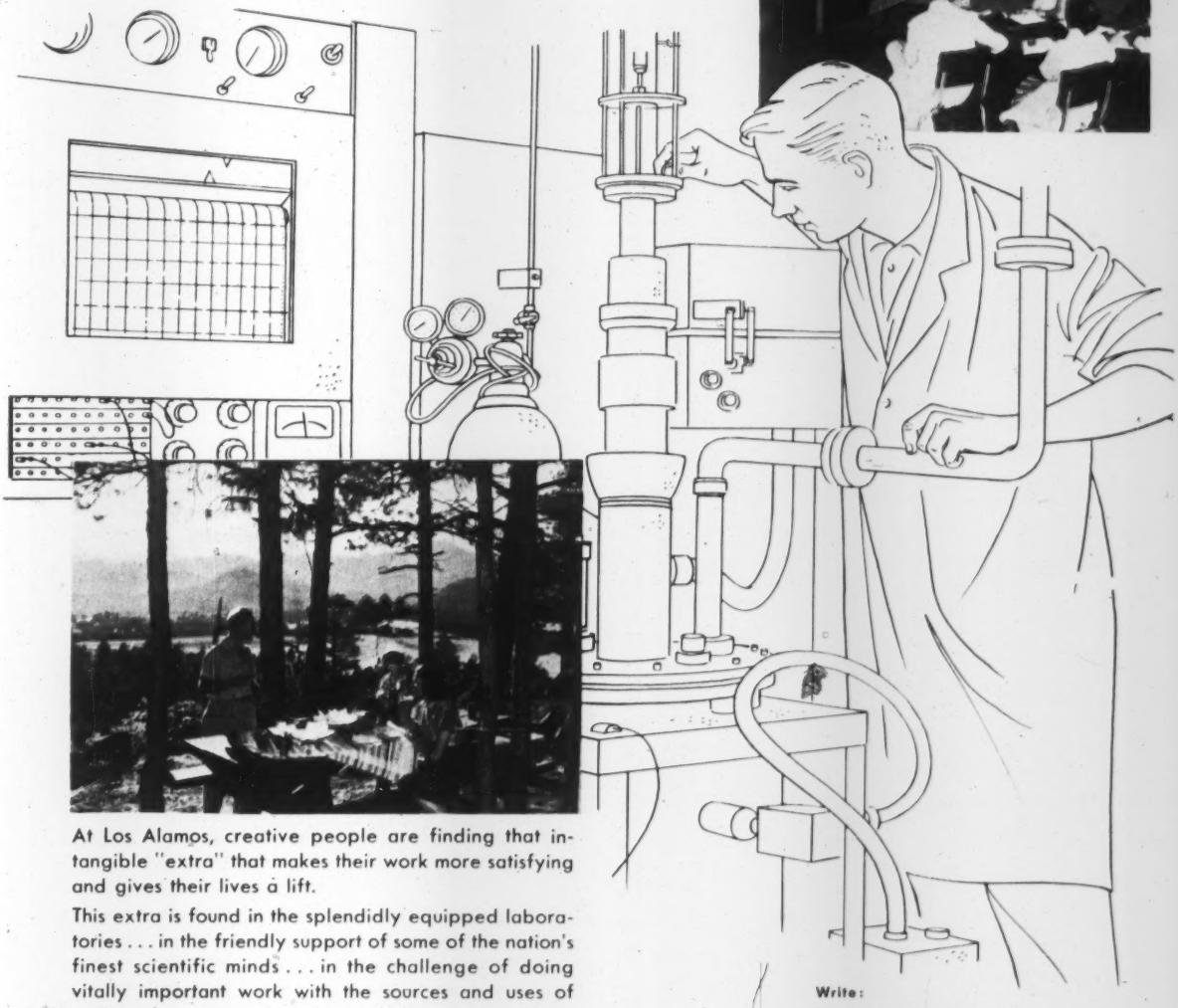

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This extra is found in the splendidly equipped laboratories . . . in the friendly support of some of the nation's finest scientific minds . . . in the challenge of doing vitally important work with the sources and uses of nuclear energy.

You'll find it, too, in the spectacular scenic setting high in the green, pine-covered mountains of Northern New Mexico . . . in the bright, clean community of 13,000 people . . . in the up-to-date shopping centers, the uncrowded schools, the many churches. It's in the healthful climate, the cool summers and the mild winters. For scientific research and enjoyable living, Los Alamos has no equal.

If you are a graduate scientist or engineer, seeking that intangible extra, your inquiry about employment will be answered promptly.

Write:
Director of Personnel
Los Alamos Scientific Laboratory
Division 2407
Los Alamos, New Mexico

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
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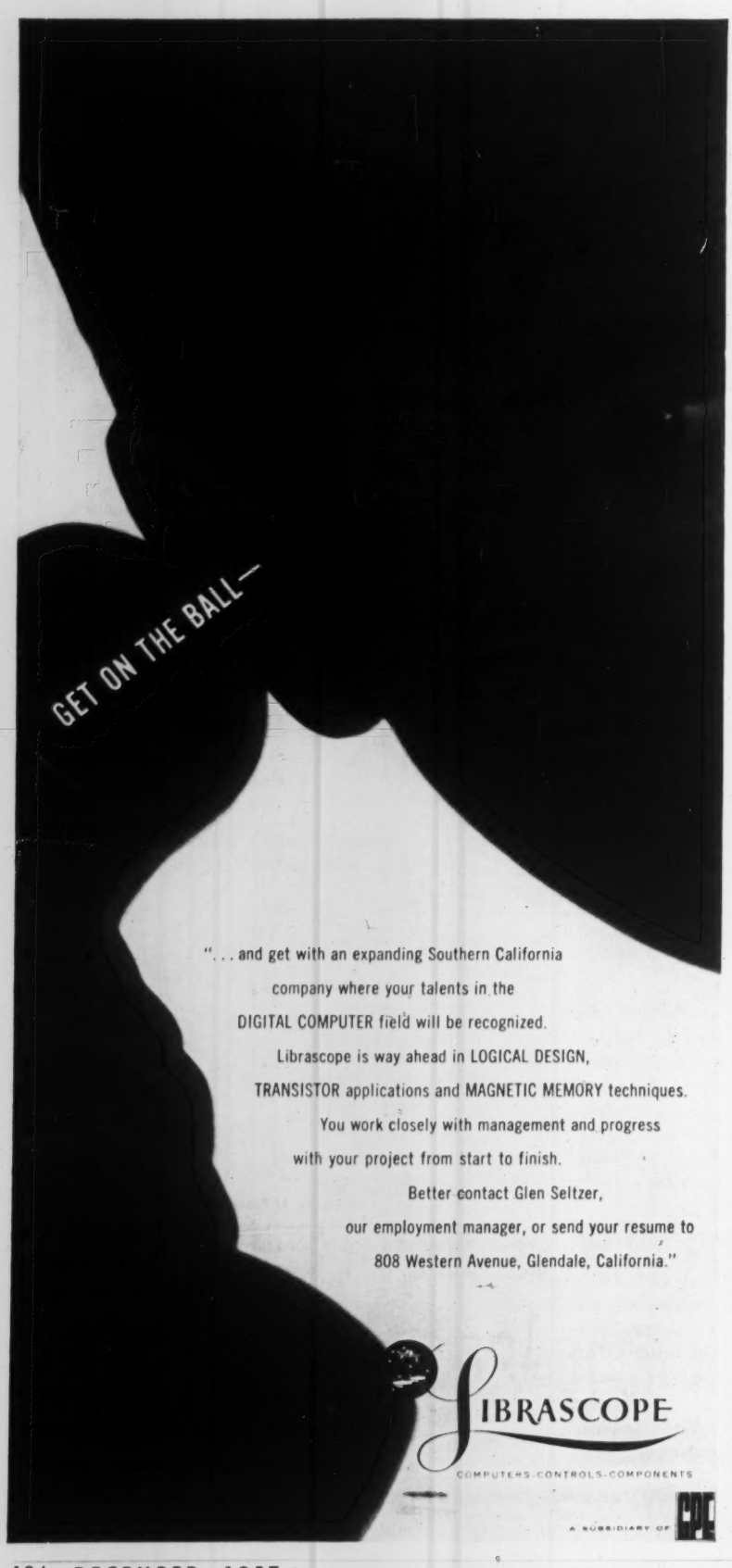
LOS ALAMOS SCIENTIFIC LABORATORY IS A NON CIVIL SERVICE OPERATION OF THE UNIVERSITY OF CALIFORNIA FOR THE U. S. ATOMIC ENERGY COMMISSION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"... and get with an expanding Southern California
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Librascope is way ahead in LOGICAL DESIGN,
TRANSISTOR applications and MAGNETIC MEMORY techniques.
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Better contact Glen Seltzer,
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808 Western Avenue, Glendale, California."
LIBRASCOPE
COMPUTERS-CONTROLS-COMPONENTS
A SUBSIDIARY OF CPC

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To assume responsibility for project ranging to $3 million. Includes design and estimating, equipment selection and procurement, scheduling and coordination of construction, start-up operations. Would be situated in new Chemical Plant Engineering Department.

REQUIREMENTS

- B.S. in Chemical or Mechanical Engineering.
- A minimum of 8 years' experience.
- Three to five years as project engineer or assistant project engineer in chemical plant design and construction for the process industry.

Work with growth company in the new Pittsburgh, noted for its expanding civic, educational and recreational facilities.

WRITE OR CALL:

J. F. Lovett, Supv., Design & Estimating
Chemical Plant Engineering Department
Pittsburgh Coke & Chemical Company
Pittsburgh 25, Pennsylvania
SPalding 1-4400

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Mechanical or electrical graduate for top staff position in leading multiplant operation in durable steel products field. Kansas City, Missouri location. Must be experienced in work involving design of new and modified plant facilities and erection supervision of installations. Superb program of compensation, benefits and paid retirement. Send full particulars, in confidence, to Orval W. Groves, Employment Supervisor at the address shown below:

BUTLER MANUFACTURING CO.
7400 East 13th Street
Kansas City 26, Mo.

DEVELOPMENT ENGINEERS

A challenging opportunity to create

Mechanical and Electrical Engineers with three to seven years of experience are offered a challenging future with a small growth company.

Responsible engineering positions exist in the machine design and development of xerographic equipment. Xerography, a process for forming and using electrostatic images, is widely used in the copying and duplicating field. It has virtually unlimited applications in automatic data processing, photography, office equipment, engineering drawing systems and interesting military applications.

Assignments are largely of the electromechanical type with a variety of optical, lighting, and electrostatic problems.

- **Comprehensive Employee Benefit Program**
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- **Ideal living and recreational area**

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Kindly send resume and salary requirements to:

FRED A. WETERRINGS
Industrial Relations Division

THE HALOID COMPANY
6 HALOID STEET
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The GENERAL *Idea*

ON ENGINEERING CAREERS

GENERAL SYSTEM

Telephone circuits are today's "superhighways" for Automation

To engineers outside the telephone industry, it often comes as a surprise to learn that telephone circuits are being widely used for transmitting all kinds of things besides the human voice.

Today, long distance lines, for instance, are alive with a variety of traffic other than words. Electrical impulses, routed along telephone circuits, are working all manner of everyday miracles . . . automatically transmitting orders from all over the country to a central warehouse in Kansas City . . . telemetering the flow of a Texas pipeline . . . monitoring radio transmitters . . . flashing burglar alarms . . . setting type simultaneously in three or four different cities.

Use of telephone circuits for automatic remote control jobs like these has recently been increasing at the astounding rate of 100% a year. Today's modern telephone company offers subscribers a "supermarket" of these specialized private-wire transmission facilities.

This broad new concept of telephone service is one of the factors behind the dynamic growth of the General Telephone System. And, in the case of General Telephone Laboratories, it presents a wide area of challenge and opportunity. Developing equipment to handle, route, transmit and receive this ever-increasing volume of high-speed traffic puts a real premium on creative engineering.

Automatic controls . . . a growing part of our work

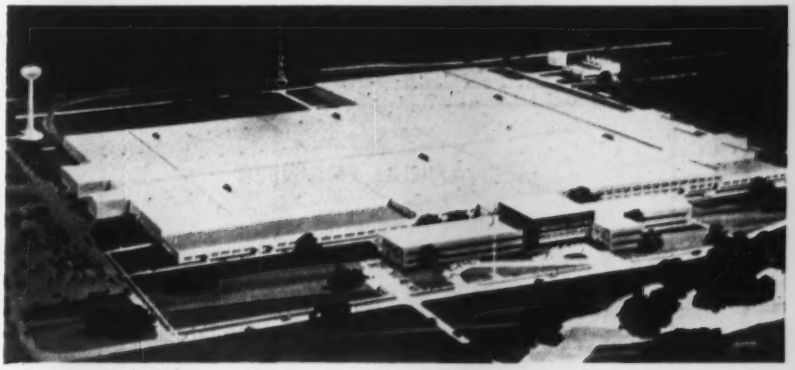
As the research and development arm of the General Telephone System, General Telephone Laboratories works in the area of automatic controls as well as telephone equipment. Our affiliated manufacturing company, Automatic Electric, was a pioneer in high-speed precision relays and stepping switches. Our laboratory group works closely with Automatic Electric in engineering new applications and new types of automatic control equipment for industry.

Security plus challenge

Our staff is expanding steadily to meet the growing needs of the operating and manufacturing companies of the General Telephone System. And our expanded research and development program in electronic switching is creating other new career opportunities.

Experience in digital computer techniques is particularly valuable to us in many phases of our work. We need men who are well qualified in Logical Circuit and System Design and Packaging, Magnetic and other Memory Devices, Time-Division Multiplexing, Semi-Conductor Research, as well as qualified Electrical and Electro-Mechanical Engineers.

If you'd like to learn more about the unusual combination of security plus opportunity in our organization, write directly to Mr. Robert Wopat, president, General Telephone Laboratories, Northlake, Illinois.



Automatic Electric's huge new plant is also the new home of General Telephone Laboratories.

GENERAL TELEPHONE LABORATORIES
INCORPORATED
NORTHLAKE, ILLINOIS

A member of the General Telephone System—One of America's great communications systems

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The present day papermaking methods were conceived and successfully applied over a hundred years ago.

West Virginia Pulp & Paper Company

believes that entirely new concepts of papermaking will be found and developed to keep pace with the future demands of home and industry.

We are presently recruiting a research and development team of:

MECHANICAL ENGINEERS
CHEMICAL ENGINEERS
PHYSICISTS

to develop and design tomorrow's methods and machines.

If you are interested and a recent graduate, please contact:

Director of Research
WEST VIRGINIA PULP
& PAPER COMPANY
Covington, Virginia

Mechanical Design Engineer Instruments

Opportunity for young engineer to become key member of design team in growing instrument company. Will be assigned project responsibility for mechanical design of standard electro-mechanical products and components under supervision of Chief Design Engineer. Company is located in attractive resort community on Lake Michigan, 1-1/2 hours from Chicago. Applicants must:

1. Have M.E. engineering degree from accredited engineering school.
2. Have a minimum of two years' experience as mechanical designer with some understanding of metal fabrication processes and shop practices, as well as an ability to prepare engineering sketches and oversee preparation of production drawings.

Salary open. Fringe benefits include profit sharing, retirement program, liberal vacation policy, medical and insurance benefits.

To apply or for more information write or telephone

Shirl Rudolph, Vice-President — Personnel
Director or Harry Eller, Chief Engineer,
THE HAYS CORPORATION
Michigan City, Indiana
TRiangle 2-5561

SUPERVISORY AND CUSTOMER CONTACT OPPORTUNITY

Mechanical, Electrical or Industrial Engineers with 3 to 7 years' experience needed for supervision of Quality Control Functions which will include Liaison work with customers. Some travel anticipated which may increase over a period of years.

Assignments relate to production of equipment and supplies for xerography, a process for forming and using electrostatic images. This process has virtually unlimited applications.

Position demands neat appearing, personable, tactful individual with a broad engineering background. Operations are in Rochester, New York, an ideal living and recreational area.

Kindly submit resume and salary requirements to:

FRED A. WETERRINGS
INDUSTRIAL RELATIONS DIVISION
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ROCHESTER 3, N. Y.

SENIOR MECHANICAL ENGINEERS

are needed by Experiment Incorporated, a leading independent research and development organization located in suburban Richmond, Virginia. Challenging openings are available in machine design, propulsion systems design and development. Excellent opportunity for experienced men with proven abilities who are interested in broad responsibility.

GRADUATE ENGINEERS

Also needed are young, imaginative engineers with bachelor's degree in mechanical or aeronautical engineering for wide range of assignments in several of our programs.

For further details, address résumés and inquiries to
Personnel Manager
EXPERIMENT INCORPORATED
RICHMOND 2, VIRGINIA

MECHANICAL ENGINEER

Bachelor's Degree or Better

Excellent opportunity investigating Domestic Burner Equipment and Fuels. Studies concerned primarily with Mechanical Factors Influencing Burner operation. Socony Mobil Oil Company, Inc., Technical Service Laboratory, 412 Greenpoint Avenue, Brooklyn 22, N. Y.

Mechanical Engineers

Research

Our Research Division has an attractive position involving a variety of challenging assignments relating to our extensive theoretical and applied research program. This program is made up entirely of civilian projects.

Nuclear Power

To keep ahead in the field of power, we are actively engaged in nuclear power generation projects. Engineers with reactor experience are urged to investigate opportunities with our rapidly developing Nuclear Power Division.

For further details, write to:
M. C. Rohm
Employment Section
Allis-Chalmers Mfg. Co.
Box 512
Milwaukee 1, Wisconsin

POSITIONS OPEN

MECHANICAL DESIGN ENGINEERS

The Eimco Corporation, a rapidly expanding construction tractor and mine loader manufacturer, seeks engineers to assume responsibilty for design and development of heavy mechanical equipment for mining and materials handling. Permanent positions. Company benefits.

If you are qualified by education and experience, we invite you to contact:

Personnel Director
The Eimco Corporation
P. O. Box 300
Salt Lake City 10, Utah

SUPERVISORY MECHANICAL ENGINEER—Duties—Developing specifications and standards for the procurement of materials handling equipment and supervising tests to determine compliance with military standards and specifications. A limited amount of traveling is required, not exceeding 15 per cent. A Bachelors Degree in Mechanical or Electrical Engineering from an accredited college or university is desired, plus at least three and a half years professional experience as a Mechanical Engineer in the field of materials handling equipment or in an allied field such as automotive or construction. In the absence of a college degree, an additional four years of Professional experience is acceptable. Writing ability is desired in addition to the technical background. Department of the Navy, Bureau of Supplies and Accounts, Bureau Civilian Personnel Division, Room 1054, Arlington Annex, Washington 25, D. C.

ENGINEERS—College positions. All sections U.S., all fields of engineering. Openings for B.S., M.S., and Ph.D's. Excellent salaries. Send pictures and qualifications to Cline Teachers Agency, Box 607, East Lansing, Mich.

MECHANICAL ENGINEER and a PHYSICIST for teaching and research. Excellent opportunity. Textile knowledge not necessary. Salary and rank open. Reply H. A. Dickert, Director, A. French Textile School, Georgia Tech, Atlanta, Georgia.

PLANT MANAGER WANTED—Plant manager with industrial and mechanical engineering background in a fast moving producing organization. Essential to know and analyze costs and schedule orders. Experience in directing plant maintenance required. Injection molding, plastisol molding and plastisol chemistry helpful. Opportunity for stock ownership. Salary open. Location: New York metropolitan area. Send detailed resume and state number of factory and supervisory personnel you were responsible for. Address CA-6374, care of "Mechanical Engineering."

ASSISTANT OR ASSOCIATE PROFESSOR of M.E. with M.S. or Ph.D. for under-graduate and graduate instruction with background in Thermodynamics and Fluid Mechanics. Twelve-month appointment. Write M.E. Dept. Head, College of Engineering, The University of Akron, Akron 4, Ohio.

WANTED: MECHANICAL ENGINEER—Experienced in construction of roll forming equipment for the production of shapes and electric welded steel tubing. Our employees know of this ad. Address CA-6371, care of "Mechanical Engineering."

POSITIONS WANTED

MECHANICAL ENGINEER—BSME—ASME member, age 24, married. Desire position in the Caribbean area. Speak fluent Spanish. 2 years of general engineering experience. Address CA-6339, care of "Mechanical Engineering."

NEW PRODUCT APPLICATION—Broad managerial and technical background in mechanical engineering. Heavy experience in chemical and nuclear aircraft jet power plants. Major accomplishments in development. Significant work in product economics, product and facilities planning, engineering contracts and licenses, financial and organization planning. Thorough understanding of new product development and application, relationships of internal company functions and customer relationships. Age 52. Interested in new product investigation, planning and application in a managerial or staff position. Address CA-6367, care of "Mechanical Engineering."

ENGINEERING MANAGER, BSME and Business. Member ASME, PE, 35, 3 yrs. Asst. Chief Engr., experience includes design, construction, maintainence of Glass melting furnaces, hydraulic and mechanical machinery, building, industrial services. Skilled engineering supervisor with proven management abilities. Address CA-6370, care of "Mechanical Engineering."

CRYOGENICS ENGINEER—BSME—15 yrs. Experience in liquid and gaseous oxygen, nitrogen, hydrogen, and acetylene. Solid experience in all phases including equipment design and development, plant engineering, sales engineering, and production plant management. Seeks position of responsibility, location immaterial. Address CA-6375, care of "Mechanical Engineering."

MECHANICAL ENGINEER–ADMINISTRATIVE ENGINEER—BME, 1950, age 34, 5 years as Project Engineer and Manager of a Military Research Section. Experience in ballistic testing, high speed photography, ammunition design, recruiting, administration of government contracts, preparation of government proposals, report writing. Administrative Engineer in Research Engineering Department devoted to development of gas heating appliances. Fifteen years' Air Force experience mostly in staff and command positions. Desire a position with responsibility. Address CA-6361 "Mechanical Engineering."

MECHANICAL ENGINEER–MANUFACTURING, BSME—10 years' experience in development, manufacture, and testing of electrical equipments and gas turbines, including 6 years' work with semi-conductor devices covering research, product development, manufacturing processes, quality control, and supervision of pilot plant and production line. Prefer New England or upper New York. Address CA-6363, care of "Mechanical Engineering."

MECHANICAL-ENGINEER '30; M.A. 8 years of varied experience ranging from research to hardware. Proven ability to assimilate new disciplines. Theoretical investigations a strong point. Computer programming experience. Seeks staff position in industrial research at $15,000 level. Free to relocate anywhere. Address CA-6366, care of "Mechanical Engineering."

SERVICES AVAILABLE

RESUMES—Send for "How to Write Your Resume" including sample guide—$1.50 postpaid. Orville E. Armstrong & Co., 55 W. 42nd St., Dept. ME, New York 36, N. Y.

BUSINESS OPPORTUNITIES

PARTNERSHIP FOR SALE—One-third interest in going successful New York City power plant equipment, commission sales representative business. Address CA-6325, care of "Mechanical Engineering."

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SALARIED POSITIONS—$6,000 to $35,000. We offer the original personal employment service (established 46 years). Procedure of high standards individualized to your personal requirements. Identity covered. Particulars—R. W. Bixby, Inc., 502 Brisbane Bldg., Buffalo 3, N. Y.

PLANT PERSONNEL, ENGINEERS, DESIGNERS—Draftsmen, Chemists, and Metallurgists, E. G. Stroud, Member ASME and President of Cleveland Engineering Agency Co., 2132 E. 9th St., Cleveland 15, Ohio, will help you find positions or men.

SALARIED PERSONNEL $5,000 to $30,000

This nation-wide service, established 1927, is geared to the needs of high grade men who seek a change of connection under conditions, assuring if employed full protection to present position. Send name and address only for details. Personnel consultation invited.

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Dept. J, P.O. Box 674, Manchester, Vermont

The Inside Story...

Your Christmas Seal letter asks you to give to the fight against tuberculosis.

Christmas Seal funds have helped cut the TB death rate 95% . . . yet TB still kills more people than all other infectious diseases combined.

So use Christmas Seals from now 'til Christmas . . . and remember to answer the letter, please.

Buy and use Christmas Seals

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Consulting Service

Manufacturers of equipment not included

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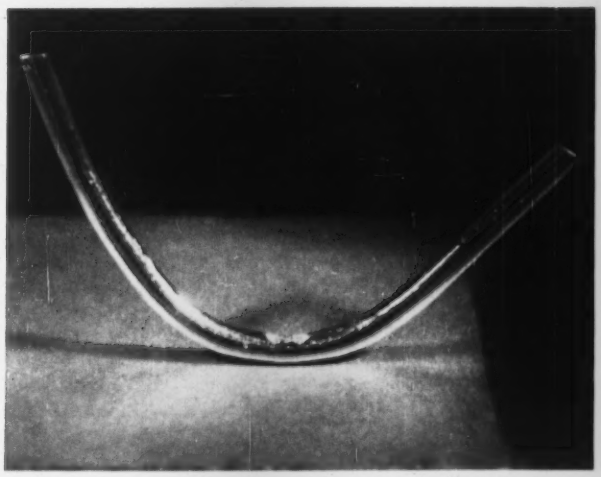
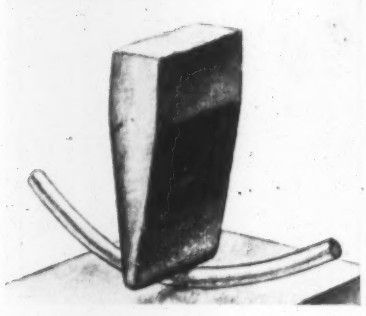


Wire bonded to germanium by thermo-compression technique (enlarged). Wires only 1/10 the breadth of a human hair have been successfully anchored to germanium wafers only three hairs thick. The bond may be an ohmic contact or rectifying contact by adding suitable impurities to the wire and the semiconductor.



One method of thermo-compression bonding. A heated wedge presses a wire against a heated semiconductor with enough force to deform the wire. Adhesion occurs in seconds.

new way to join metal to semiconductors

Thermo-compression bonding provides a new way to attach a wire to a semiconductor. It calls for heat and pressure—nothing else. The wire and the semiconductor are moderately heated, then pressed together under moderate pressure. The resulting bond is very strong—stronger actually than the wire. No chemical flux or molten metal is required.

Eliminating molten metal provides an enormous advantage in fixing electrical connections to transistors. That's because molten metal tends to spatter and spread uncontrollably over the surface of a semiconductor. And it may alloy with the semiconductor to alter its all-important crystalline structure and chemical purity. Thermo-compression bonding easily and quickly makes a strong permanent electrical connection without damaging the semiconductor. Furthermore, the lead may be attached to microscopic areas and precisely positioned, a most valuable aid in the construction of high-frequency transistors.

Thermo-compression bonding will speed the production of transistors . . . the transistors needed to fill all the new jobs Bell Laboratories finds for them in the quest to provide still better telephone service to our growing country.

At Bell Labs Howard Christensen and Orson Anderson discuss their discovery of new bonding principle with Peter Andreatch, Jr., who collaborated in the studies.

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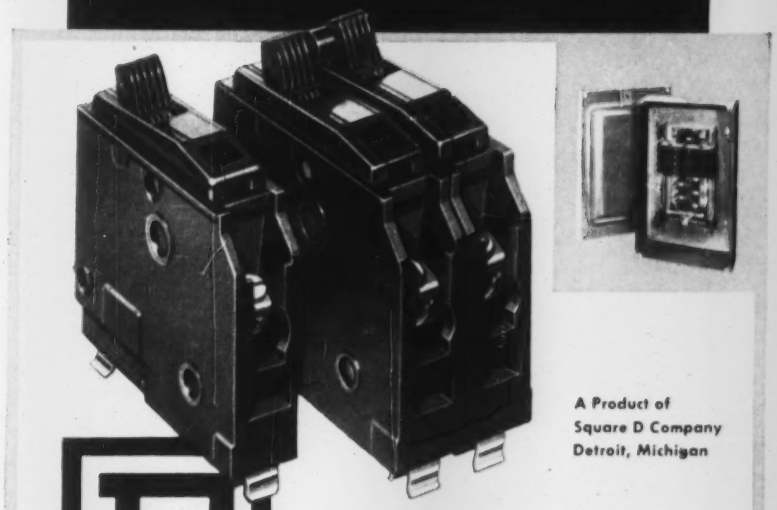

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QO CIRCUIT BREAKER LOADCENTERS

The QO Loadcenter by Square D Company is typical of the skillful design and fine construction which distinguishes this famous manufacturer's entire line of products. Trip elements are the highly-efficient thermal and independent magnetic type. Overloads are controlled by a direct-heating bimetal element, protected by a special "arc chamber" which completely shields the sensitive bimetal from hot blasts. An auxiliary bimetal element provides temperature compensation against the heat of the sun, furnaces, enclosures, etc. Silvered plug-in jaws and silvered connectors are used to provide better line connections. Operating handles are designed for quick, positive trouble-circuit identification. And the swing-grip mounting lets the installer mount the breaker in a matter of seconds.

With such painstaking attention to design details, it is only natural that Square D should specify Chace Thermostatic Bimetal for the QO breaker. Precision-rolled to the closest tolerances—specially processed for a *permanent* metal bond—tested under various conditions—and carefully inspected to assure quality of product, Chace Thermostatic Bimetal provides instantaneous, automatic, and unfailing protection of valuable equipment. In *your* product planning, specify Chace Thermostatic Bimetal . . . ultimate result of over a third of a century's exclusive production of precision bimetal.

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Thermostatic Bimetal
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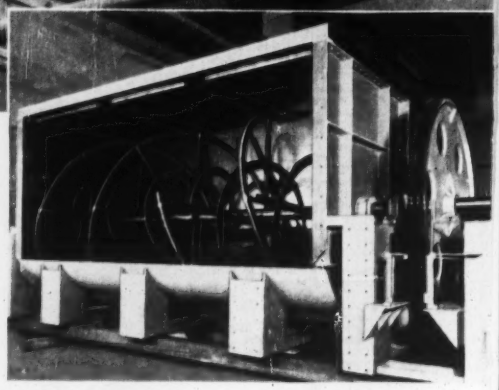
WORLD'S LARGEST BLENDER

Mixes 30 tons of Dextrin at once!

The J. H. Day Company personnel shown with Twin Jumbo Blender. It is 17 feet wide, 18 feet long— has twin spiral agitators 9 feet in diameter.



Half tank cross-section shows one 9 foot agitator and huge sprocket. *Diamond* triple strand 2" pitch Roller Chain drives agitator at 10 R.P.M.

Mixing a carload of dextrin in one batch is a mammoth job. It requires big power correctly applied. For the final agitator drive, J. H. Day engineers selected Diamond Roller Chains. Their high uniform quality is assurance of maximum efficiency and years of maintenance-free performance.

Whatever your drive problem is, fractional or several thousands of horsepower, high speed or low, Diamond Roller Chain will serve you efficiently at low cost. Diamond Engineers are available to give you valuable assistance. Call on them now.

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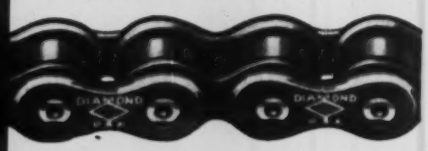
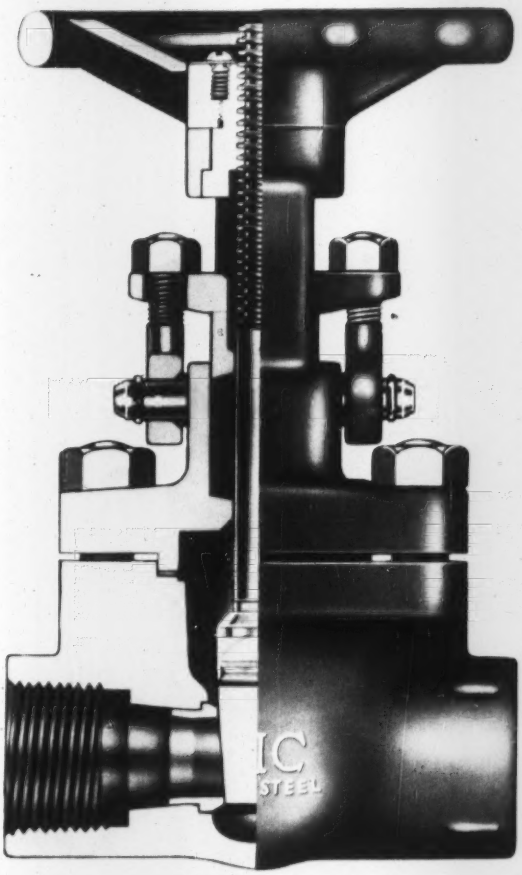
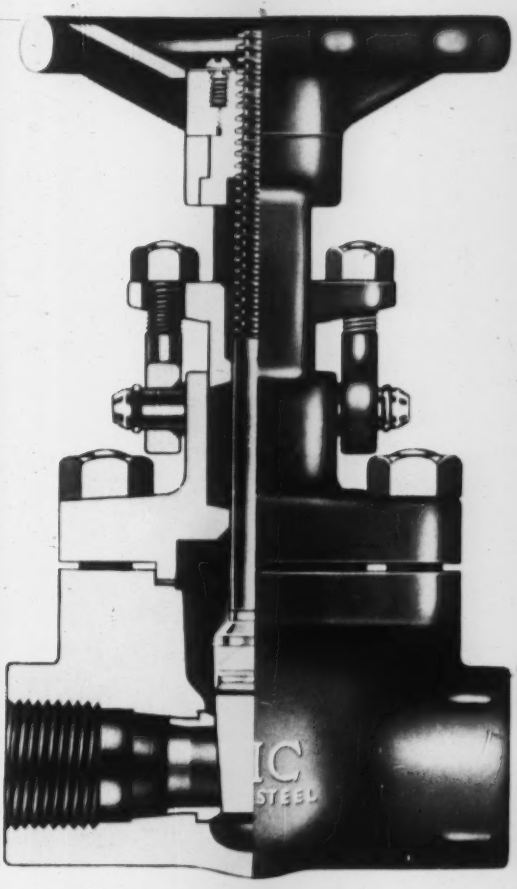


DIAMOND **ROLLER CHAINS**

1100 LINE

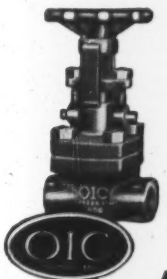


1300 LINE



New, OIC bolted bonnet, 600 lb. forged steel gate valve lines, ½" to 2" with HCH, all purpose trim.

2 new rugged OIC forged steel lines



Both feature the modern and rugged bolted bonnet joint, which simplifies and lowers the cost of maintenance.

Both feature a soft iron gasket securely retained in the bolted male and female body-bonnet connection to assure enduring tightness.

Both feature 13% chrome stainless steel trim with 1000 Brinell, duracased wedges.

Both feature plenty of gripping area for pipe wrenches on pipe ends; there's no interference with body-bonnet flanges. Simplifies joint make-up!

The 1300 line includes a *high flow* port area, offering full-flow characteristics.

The 1100 line, with standard flow ports, is compact, economical, and includes the same high quality, rugged features and trim as the 1300 line.

Most valve users have applications suited to both of these new OIC valve lines. Write for Bulletin *#195-R* illustrating features and specifications that fit these newest forged steel valves to your services.

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and there's
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